Mount Rainier National Park
Fire Management Plan
Environmental Assessment

December 12, 2003

Mount Rainier National Park
Tahoma Woods, Star Route

Ashford, Washington

United States Department of the Interior • National Park Service • Mount Rainier National Park

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EXECUTIVE SUMMARY

The purpose of this Environmental Assessment is to consider the impacts of implementing various fire management strategies on Mount Rainier National Park resources (including natural and cultural resources, visitor experience and park operations). Each of the five alternatives presents a different overall strategy for the park's fire management program. All, however, address the common goal of preserving park resources while protecting human life and property.

In addition to providing information required by law and policy, this Fire Management Plan and Environmental Assessment respond to the 2001 National Fire Policy Review. This Environmental Assessment is consistent with federal, state and local law, NPS and other applicable policy and addresses impacts on a full array of park resources, including:

- air and water quality
- water quantity
- vegetation
- wildlife
- rare, threatened and endangered species
- archeological resources
- historic structures
- cultural landscapes
- wilderness
- visitor experience (including human health and safety) and
- park operations.

Each of the following five alternatives would meet the purpose and need. The preferred alternative (to employ the full range of fire management strategies available) would best meet this need. This alternative maximizes flexibility in meeting ecosystem management goals, while adopting the best management practices to manage the effects of fire on endangered species, ecosystem functions and air quality (smoke management).

Alternatives

1: No Action: Suppress All Wildland Fires, Conduct Limited Debris Burning And Manual/Mechanical Treatment Hazard Fuel Reduction

2: Wildland Fire Suppression And Wildland Fire Use For Resource Benefits

3: Wildland Fire Suppression, Wildland Fire Use For Resource Benefits, And Prescribed Fire (Management Ignited Wildland Fire)

4: Wildland Fire Suppression, Wildland Fire Use For Resource Benefits, And Hazard Fuel Reduction (Debris Burning and Manual/Mechanical Treatment)

5: Wildland Fire Suppression, Wildland Fire Use For Resource Benefits, Prescribed Fire And Hazard Fuel Reduction (Manual/Mechanical Fuel Reduction and Debris Burning) (Preferred/Environmentally Preferred)

I. INTRODUCTION

Mount Rainier National Park encompasses 235,625 acres on the west side of the Cascade Range, about 65 miles southeast of Seattle and 65 miles west of Yakima. The park was established in 1899 ". . .for the benefit and enjoyment of the people. . ." The park is managed to "provide for the preservation from injury or spoliation of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition" (Mount Rainier National Park Organic Act 1899).

This Environmental Assessment is prepared to satisfy the requirements of the National Environmental Policy Act (NEPA) (1969), as amended. NEPA requires the documentation and evaluation of potential impacts resulting from federal actions on lands under federal jurisdiction. An Environmental Assessment discloses the potential environmental consequences of implementing a proposed action and other reasonable and feasible alternatives.

NEPA is also intended to provide decision- makers with sound knowledge of the environmental consequences of the alternatives available to them. In this case, the superintendent of Mount Rainier National Park and the Pacific West Regional Director are faced with a decision to amend the park's fire management plan as described herein. The selected alternative will guide the fire management program. As described herein, the development of Prescribed Fire plans would also undergo future, more specific, environmental analysis.

II. PURPOSE

The purpose of this Environmental Assessment is to adopt a revised Fire Management Plan for Mount Rainier National Park that will increase the role of fire as a natural ecosystem process to the park while meeting new National Park Service directives and guidelines. Wildland fire is a natural process. As a result, there is an ongoing park need to ensure the perpetuation of park ecosystems and natural ecosystem processes, while employing a fire management program that provides for the protection of life, property and cultural and natural resources. This plan includes an array of fire management strategies designed to meet fire and resource objectives. While Fire Management Plans are normally revised every five years, they typically do not undergo extensive changes. As a result, upon approval, this Fire Management Plan revision would guide park fire management through the foreseeable future. The proposed plan described in this Environmental Assessment responds to significant changes in National Park Service policy regarding Fire Management Plans.

National Park Service Fire Management Plans are both planning and operational documents that ensure the protection of life and property and sensitive natural and cultural resources, while advocating the perpetuation of natural ecosystem processes.

Mount Rainier National Park's Fire Management Plan will:

- meet the requirements of NPS Management Policies (2001);
- fulfill the ecosystem management goals in the park General Management Plan (2001) and Natural and Cultural Resources Management Plan (1999);
- meet the requirements of the National Environmental Policy Act and other laws related to natural and cultural resources; and
- implement a strong fire management policy and operational procedures for the park that will enable natural fires to approximate natural fire rotation in the park ecosystem.

The fire management plan will also guide park fire management activities and decisions, including:

- how the park would respond to wildland and human- caused fires;
- what actions the park would take to protect human life and property from wildland fire;

- what measures the park would take to protect special resources and wilderness character from the impacts of wildland fire or fire suppression;
- the types of hazard fuel reduction that would occur; and how prescribed fire might be used to accomplish resource management and research objectives as well as fire management protection objectives.

III. NEED

The primary purpose of the Fire Management Plan is to return fire as a natural ecosystem process to Mount Rainier National Park. In fulfilling this purpose, the equally important considerations of protecting life and property are of utmost concern.

Without a currently approved fire management plan, Director's Order 18: Wildland Fire Management (NPS 1998), states that "park areas must take an aggressive suppression action on all wildland fires, taking into account firefighter and public safety and resources to be protected within and outside the park." The 1988 Mount Rainier National Park Fire Management Plan was in the process of being revised when in 1995 it became obsolete. That year, new NPS policy declared that all park fire management plans must be revised to correspond with new guidelines. Director's Order 18 and its accompanying Reference Manual (NPS 2001) of the same number and title reiterated the need for Fire Management Plans to meet new guidelines. Absent revision to these directives, Fire Management Plans generally are revised every five years.

According to National Park Service Management Policies (NPS 2001:4:38), "all NPS Units with vegetation that can sustain fire must have a Fire Management Plan" to guide a fire program that responds to natural and cultural resources management objectives; provides for the safety of park visitors, employees, neighbors and developed facilities; and addresses potential impacts to adjacent public and private property.

Fire Management Plans are also dictated by the Department of the Interior's *Departmental Manual* for all lands administered by the Department (USDI 1997).

IV. BACKGROUND

The fire management plan's purpose, goals and objectives are derived from agency mandates, policy statements, environmental laws and park planning documents. The Fire Management Plan must respond to direction provided in Federal and NPS policy statements such as the 2001 Review and Update of the 1995 Federal Wildland Fire Management Policy (USDI *et al.* 2001). The fire program must comply with laws such as the National Park Service Organic Act, Endangered Species Act, Clean Air Act, Clean Water Act, Wilderness Act, National Historic Preservation Act and Archeological Resources Protection Act, and other laws related to the managing park resources. The park's General Management Plan (NPS 2001), Natural and Cultural Resources Management Plan (NPS 1999) and previous fire management plans provide more specific direction regarding park objectives and resources.

RELATIONSHIP TO GENERAL MANAGEMENT PLAN

One goal of the General Management Plan (NPS 2001) is to perpetuate park ecosystem processes within their broader ecosystem context, using management decisions based on adequate scholarly and scientific information. Another goal states that "plant communities and the processes governing them will continue unaltered in the majority of the park." To further these goals, the GMP also states that "cooperative agreements will be sought with other adjacent land management agencies to protect ecosystem habitat. . ."

The GMP calls for a Fire Management Plan:

> A collaborative fire management plan would be prepared between the park and other land management agencies. Eventually, the park staff would work toward developing a joint fire management plan with land management agencies on its boundary. This collaborative plan would ensure coordinated fire management across the principal U.S. Forest Service/National Park Service boundary. Other surrounding national forests, including the Mount Baker- Snoqualmie, Gifford Pinchot and the Wenatchee National Forests, would also be part of the process. Based on fire history, topography, and other issues, the plan would identify fire management units throughout the park and would address wildland fire for resource benefits, suppression, mechanical hazard fuel reduction, prescribed fire and other alternatives for the park's fire management program.

RELATIONSHIP TO PAST FIRE MANAGEMENT PLANNING

The first fire plan, the Fire Control Plan (1979) focussed on ensuring reasonable protection of park structures and facilities and suppression of wildfires.

The existing Fire Management Plan (1988) called for broader use of fire in an ecosystem (primeval wilderness character) context to return fire and fire effects to their natural role in the park. Its objectives included:

- enabling naturally occurring fires to burn within designated prescriptions;
- using prescribed fire as a tool to restore ecosystem processes;
- suppressing all human- caused fires and fires within established exclusion zones;
- expanding ongoing public education;
- manual/mechanical removal of hazardous fuels near historic and administrative facilities;
- establishing and maintaining interagency cooperation;
- maintaining trained personnel; and
- systematizing fire procedures, standards and responsibilities in the park.

Under the selected alternative in the 1988 FMP, the park was divided into three zones: a fire exclusion zone, a conditional zone and a prescribed natural fire zone. All naturally occurring fires within the conditional and prescribed zones were initially to be considered prescribed. From there, each ignition would be analyzed and declared either prescribed or a wildfire.

The fire exclusion zone was established based on the lack of agreement to accept fire across the park

boundary and developed areas at risk to wildfire. The conditional zone enabled all human- caused fires to be suppressed and other fires to be controlled as needed to limit spread into some areas. In the prescribed natural fire zone, all human- caused fires would also be suppressed and all lightning fires allowed to occur, with suppression actions determined on a case- by- case basis.

The accompanying Environmental Assessment and Finding of No Significant Impact (March 25, 1988) for the 1988 FMP also considered other alternatives such as permitting all fires to burn and suppressing all fires.

Changes in NPS fire management policy and revisions to key national fire policy make this 1988 FMP obsolete, requiring a revision that incorporates these policy changes.

The Fire Management Plan (FMP) is an addendum to the Natural and Cultural Resources Management Plan (Mount Rainier National Park 1999). That plan calls for the implementation of a new FMP that utilizes minimum impact fire suppression techniques, and the use of prescribed and natural wildland fire to restore the historic role of fire and to perpetuate ecosystem health. The current revision to the FMP also calls for developing a better understanding of burning by native people to maintain specific resource conditions as well as additional research on a wide variety of other topics related to historic and prehistoric fire in Mount Rainier National Park.

RELATIONSHIP TO NPS LAW AND POLICY

NPS Management Policies (2001) and the Director's Order and Reference Manual on Wildland Fire Management (NPS 1998 and 2001, respectively) call for all areas with burnable vegetation to have an approved FMP. Servicewide fire management funding is provided by the U.S. Congress. The authority for fire management is contained in DOI policy (http://elips.doi.gov/elips/) and the National Park Service Organic Act:

> ". . .to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1a1)."

As mentioned above, Mount Rainier National Park was set aside to:

> ". . .provide for the preservation from injury or spoliation of all timber, mineral deposits, natural curiosities, or wonders. . .and their retention in their natural condition."

National Park Service Management Policies (NPS 2001, Section 4.5 Fire Management) states:

> Naturally ignited fire is a process that is part of many of the natural systems that are being sustained in parks. Human- ignited fires often cause the unnatural destruction of park natural resources. Wildland fire may contribute to or hinder the achievement of park management objectives. Therefore, park fire management programs will be designed to meet park resource management objectives while ensuring that firefighter and public safety are not compromised.

ISSUES IDENTIFIED IN SCOPING

The park received five comment letters in response to a public scoping letter and proposal sent out on January 26, 2001. All were from agency representatives. The Okanogan- Wenatchee National Forest (2- 15- 01) responded that they were revising their FMP and that they would like to interface in planning. The Washington State Historic Preservation Office (2- 14- 01) responded with a recommendation to fully incorporate cultural resources issues into the park planning efforts and to consult with concerned tribes regarding cultural resources issues and fire planning. The Puget Sound Clean Air Agency (2- 13- 01) urged the park to incorporate strategies that would reflect the State of Washington's visibility State Implementation Plan (SIP), which was developed to help protect class I areas in the state designated by the Clean Air Act. Another individual from the same agency questioned whether the plan would comply with the smoke management protocols in the SIP which are managed under the Washington State Environmental Protection Act (SEPA). The Washington State Department of Natural Resources (DNR) recommended not pursuing fire suppression, but rather implementing wildland fire use in wilderness as well as encouraging the

park to consider the use of prescribed fire in whitebark pine woodlands.

Prior to the release of this plan to the public, internal park and agency and area tribal comments were sought. The Muckleshoot Indian Tribe responded with a detailed comment letter, including a request to strengthen the link between Native Americans and the use of fire in several sections in the Environmental Assessment and to consider the issue of environmental justice as it related to tribes and fire management.

V. Fire Management Goals and Objectives

To guide fire management decision- making and short- and long- term strategies, park fire management staff have identified the following goals and objectives.

1. Ensure that firefighter and public safety is the first priority in every fire management activity.

Initial Objectives:

- At all times, fire personnel will comply with National Wildfire Coordinating Group (NWCG) guidelines, agency fitness standards and wear personal protective equipment appropriate to their assignment.
- Ensure all fire management activities sustain no injuries to the public and limit the number of annual injuries to fire personnel to no more than 10% of the past five- year average.

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* - page 21, Guiding Principle #1; *Management Policies 2001* - Sections 4.5 Fire Management, 8.2.5.1 Visitor Safety, 9.1.8 Fire suppression; *Director's Order #18: Wildland Fire Management (*NPS, 1998*)* - Section 5.1 Safety and Health.)

2. Restore and maintain natural fire regimes to the maximum extent practicable to ensure unimpaired natural ecosystem functioning.

Initial Objectives:

- By Summer 2004, allow 90 percent of natural fires in the non- suppression unit to burn in order to restore a normal distribution of historic fire frequencies
- For every wildland fire, conduct a "Wildland Fire Implementation Plan, Phase 1" within 2 hours of detection and size- up.
- Record major fire behavior and decisions, determine whether specific objectives are being met and assess fire effects of every wildland fire event.
- Conduct future research to enable the park to determine the role of fire in maintaining selected ecosystems.
- Every three years if funding is provided, identify and evaluate the changes in landscape patterns in and adjacent to the Park that are the result of fires.

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* - page 23, Policy Statement #4; *Management Policies 2001* - 4.1 General Management Concepts; *Director's Order #18: Wildland Fire Management* - Section 4 Operational Policies and Procedures.)

3. Protect Cultural Resources (including prehistoric sites, ethnographic resources cultural landscapes, and historic structures) through the use of hazard fuel reduction, and prescribed fire.

Initial Objectives:

- If funding is provided, complete a needs assessment/survey of the fire hazards around the Park's developed areas by spring 2005.

- For every wildland fire and wildfire event, identify and implement appropriate management responses and strategies that address site specific cultural and natural resource management concerns.
- By spring 2005, create defensible space using an appropriate fuel reduction technique around vulnerable prehistoric and historic resources. (providing the project is funded)
- By 2007, in 80% of the park's developed zones, change ground fuel conditions so that the predicted flame lengths under extreme weather conditions will be less than four feet. (providing the project is funded)

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* – pages 22-23, Policy statements #3 and #7; *Management Policies 2001* - Section 5.3.1.2 Fire Detection, Fire suppression, and Post-fire Rehabilitation and Protection, and Section 9.1.8 Structural Fire Protection and Fire suppression; *Director's Order #18: Wildland Fire Management* - Section 4.4.c. Operational Policies and Procedures.)

4. Protect Natural Resources (including flora, fauna, air quality, geologic resources, aquatic resources and wilderness character) from adverse effects of wildland fires, fire suppression, prescribed fires, and manual/mechanical treatments.

Initial Objectives:

- For every fire management activity (suppression, prescribed fire, fire use and mechanical fuels reduction), identify and implement appropriate management responses and strategies that address site- specific cultural and natural resource management concerns.
- Annually update fire management program objectives and/or actions, based on the evaluations and results of fire effects monitoring information.
- Include documented mitigation measures to protect air quality values in prescribed burn plans.
- Consider air quality impacts for all wildland and prescribed fires within the go/no go decisions.
- During all wildland fire projects, use strategies that will not exceed 80% of the state standards for carbon monoxide and particulate in smoke sensitive areas and which do not degrade park visibility for more than four consecutive days.

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* - page 22, Policy statements # 2 and #3; *Management Policies 2001* - Section 4.1 General Management Concepts, Section 9.3.9 Wilderness Fire Management, and Section 4.5 Fire Management; *Director's Order #18: Wildland Fire Management* - Section 3 NPS Management Policies, Section 4.4.c. Operational Policies and Procedures, and Section 5.10 Debris Disposal.)

5. Reduce hazardous accumulations of fuels near structures, roadways and wildland-urban interface areas.

Initial Objectives:

- Complete a needs assessment/survey of the fire hazards around Park's historic and developed areas by spring 2006, pending the project is funded.
- By spring 2006, once the project is funded, create defensible space using an appropriate fuel reduction technique around vulnerable prehistoric and historic resources.
- By 2007, in 80% of the park's developed zones, change ground fuel conditions so that predicted flame lengths under extreme weather conditions will be less than four feet.

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* – page 23, Policy statement #7; *Management Policies 2001* - Section 9.1.8 Structural Fire Protection and Fire suppression; and *Director's Order #18: Wildland Fire Management* - Section 5.9 Fuels Management)

6. Maintain preparedness for park, agency and interagency fire response.
Actively participate in regional and national wildland fire response, analysis and management.

Initial Objectives:

- By 2005, the park will have established qualifications and promote staff training to achieve a Type III fire management organization. This team, with the assistance of the surrounding Forests, would be

available during fire season and be able to contain 90% of all unwanted fires in the park. Since Mount Rainier NP is not a fire pro park, this objective will need additional dollars allocated by Region in order to be achieved.
- Annually, support the regional and national fire organization, by having employees on area committees or by hosting fire related training within the park.
- Support qualified employees to become members of local and national fire teams.
- Utilize developmental training opportunities in and outside the park yearly, to increase the skills of the staff.

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* – page 24, Policy statement #10; and *Director's Order #18: Wildland Fire Management* - Section 5.5 Preparedness)

7. Maximize the efficiency of the fire management program by coordinating with other park divisions, neighboring agencies, Native American Tribes and private land owners. Promote educational awareness of the fire management program in park staff and the general public.
Initial Objectives:

- On an annual basis, review and revise the FMP with adjacent agencies, including the Puget Sound Interagency Communication Center (PSICC).
- Foster a public understanding of fire management objectives through interpretive and educational opportunities annually.
- When funding is available, jointly oversee the preparation, presentation of interpretive, educational programs and/or materials designed to foster understanding of the park fire management program.
- By 2006, with the assistance of the interpretive division, develop and support an informal network of key local and public relation contacts to coordinate fire information in a timely manner.
- Annually review and revise, as needed, the "Public Fire Information Plan" and "Prevention Plan" and delineate a yearly implementation process.

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* – page 24, Policy statement #14; *Management Policies 2001* - Section 2.3.1.9 Cooperative Planning, and Section 4.1.4 Partnerships; and *Director's Order #18: Wildland Fire Management* - Section 4.4 Operational Policies and Procedures)

7. Evaluate the costs and benefits of alternative fire management strategies to ensure that financial costs are commensurate with protection or enhancement of resource and wilderness values.

Initial Objectives:

- Annually, review, update and initiate cooperative agreements to assure that interagency approaches to managing wildland fires are implemented.
- Create and maintain annually, mutual support agreements with adjacent land management agencies to allow naturally ignited fires, burning within prescription, to enter or exit adjacent wilderness.
- Meet annually, or as often as needed, with neighboring private landowners, to promote a partnership in managing fires on an ecosystem basis

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* – page 22, Guiding principle #5, and page 24, Policy statements #10 and #11; and *Management Policies 2001* - Section 4.5 Fire Management)

9. Employ adaptive management strategies. Scientifically manage wildland fire using the best available technology. Use information gained through inventory and monitoring to evaluate and improve the program. Develop a better understanding of the role played by humans in historic and pre-historic fire regimes.

Initial Objectives:

- Annually support currently funded research regarding the role of fire in Cascades whitebark pine communities.
- Develop research funding proposals for additional research needs, based on initial whitebark pine study and other identified needs within the next eight years.
- Annually, use research to advance understanding of fire behavior, effects, ecology and management.
- Coordinate with Native American Tribes to compile ethnohistoric information on burning in the park and the surrounding national forests.

10. Integrate fire management with all other aspects of park management.
Initial Objectives:

- Maintain a team approach to fire management where all divisions or expertise within the park and available outside resources are represented and assist in the management of fire within the park.
- Use research to advance understanding of fire behavior, effects, ecology and management.
- Weather- Provide annual fire danger and situation information.

(Basis: *Review and Update of the 1995 Federal Wildland Fire Management Policy* - page 21 Guiding Principle #6; *Management Policies 2001* – Section 2.3.1.5 Science and Scholarship; and *Director's Order #18: Wildland Fire Management* – Section 4.4.g).

VI. ALTERNATIVES

The following alternatives were developed by a park interdisciplinary team, using established fire management strategies from new NPS fire management policy. Public input was sought to validate the need for a new FMP and to help identify the appropriate strategies and impact topics (potentially affected resources).

1: No Action: Suppress All Wildland Fires, Conduct Limited Debris Burning and Manual/Mechanical Treatment Hazard Fuel Reduction

2: Wildland Fire Suppression and Wildland Fire Use For Resource Benefits

3: Wildland Fire Suppression, Wildland Fire Use For Resource Benefits, and Prescribed Fire (Management Ignited Wildland Fire)

4: Wildland Fire Suppression, Wildland Fire Use For Resource Benefits, and Hazard Fuel Reduction (Debris Burning and Manual/Mechanical Treatment)

5: Wildland Fire Suppression, Wildland Fire Use For Resource Benefits, Prescribed Fire and Hazard Fuel Reduction (Manual/Mechanical Fuel Reduction and Debris Burning) (Preferred/Environmentally Preferred)

FIRE MANAGEMENT STRATEGY DEFINITIONS

The following fire management strategies: Wildland Fire Suppression, Prescribed Fire, Hazard Fuel Reduction – Debris Burning and Manual/Mechanical Treatment, and Wildland Fire Use for Resource Benefits are defined below with respect to NPS fire policy and proposed park use. The definitions come from the most recent Director's Order on Fire Management (DO 18: Wildland Fire Management).

Fire Management Units

To enable fire management plans to be more effective, *fire management units* are designated. A *fire management unit* (FMU) is any land management area defined by common objectives, land features, access, values to be protected, political boundaries, fuel types, major fire regimes or agency designated special

management areas (i.e. wilderness area). Each FMU contains fire management strategies, including possible constraints that would accomplish pre- defined objectives.

Wildland Fire Suppression

> *Wildland fire suppression is an appropriate management response to wildland fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire. All wildland fire suppression activities provide for firefighter and public safety as the highest consideration, but minimize loss of resource values, economic expenditures, and/or the use of critical firefighting resources (NPS, et al., 1998).*

A variety of fire suppression techniques are used to break the continuity of forest fuels, cool a fire, and to slow the advance of a flaming front. Actions may include constructing fire lines; cutting vegetation; applying water, foam or retardant; and using fire. Most park fires are small and can be suppressed using hand tools - sometimes supported with a chainsaw for cutting fuels, a fire engine or portable pump for delivering water; and/or a helicopter to transport water, supplies, and firefighters. Larger fires or fires with greater potential to spread may require the use of drip torches, fusees, fire line explosives, retardant- filled aircraft or extensive water drops.

Wildland Fire Use for Resource Benefits

> *Wildland fire use is the management of naturally ignited wildland fires to accomplish specific pre- stated* [defined] *resource management objectives in predefined geographic areas (NPS, et al., 1998).*

Naturally ignited (lightning or volcanic) wildland fires would receive management actions appropriate to conditions of the fire, fuels, weather, and topography to accomplish specific objectives for the individual fire. These management actions, defined as the "appropriate management response," may vary from fire to fire and even along the perimeter of an individual fire. Management options range from monitoring with minimal on- the- ground actions to intense fire suppression actions on all or portions of the fire perimeter. The appropriate management response is developed from analysis of the local situation, values- to- be-protected, management objectives, external concerns, and land use. To use this strategy, the fire manager, in consultation with an interdisciplinary team, would determine that a natural wildland fire would provide resource benefits if managed under specific conditions within a maximum manageable area (MMA). This strategy would then be used to incorporate suppression- "holding"- actions on sections of the fire perimeter to keep the fire within the predetermined MMA, while allowing other natural features to check the spread of the fire on other perimeters within the MMA. Depending on fire location, size, spread, resource values at risk and other factors, management of Wildland Fire Use requires a variety of actions that could include keeping the fire out of heavy fuels if the fuels produce too much smoke; keeping the fire away from sensitive resources; and keeping the fire from burning buildings, etc.

Hazard Fuel Reduction: Manual/Mechanical Treatment

Manual treatment is the use of hand tools or hand operated power tools. Mechanical treatment is the use of heavy equipment. Both are used to cut, clear or prune herbaceous and woody species to effectively reduce hazardous accumulations of wildland fuels and to create defensible space near structures. In the park, manual treatment could be used 1) to remove excess woody debris from the ground; 2) to remove "ladder" fuels, such as low limbs and brush (which could carry fire from the forest floor into the crowns of trees); and 3) to thin dense stands of trees, near developed areas, to reduce the horizontal continuity of fuels. Occasionally, larger mechanized equipment (a boom truck and front end loader) would be used to move large boles, with the restriction that the equipment would not be driven off road or used outside of developed areas. Material cut or gathered through manual/ mechanical treatment would either be cast back on site, be disposed of by piling and burning at an established burn pit, depending on the size, quantity and location of woody materials, and/or be chipped.

Hazard Fuel Reduction: Debris Burning
Debris disposal is burning of wildland fuels generated from maintenance activities (such as grass or brush mowing or clippings), hazard tree removal, or during construction activities. These materials must be deemed infeasible or impractical to mechanically remove and must be in a non- wildland fuel environment (parking lot, boneyard, gravel pit, etc.) Any material being burned for debris disposal must be classified as permissible to burn under applicable federal, state, tribal and local regulations.

Debris burning (in small piles) is used to dispose of vegetative material that has been concentrated by manual or mechanical methods.

Prescribed Fire
Prescribed Fire is any fire ignited by management actions to meet specific objectives. The fuels to be burned may be in either their natural or modified state. The prescribed burn would take place under specified environmental conditions (e.g. weather and fuel moisture); would be confined to a predetermined area with a pre- determined range of fire intensity and rate of spread. These would enable attainment of planned management objectives, including conformance with an approved prescribed fire plan that meets NEPA and NHPA requirements prior to ignition.

The "prescription" for a prescribed fire contains key weather and fire behavior parameters necessary to achieve desired fire behavior and results. For example, a prescription might specify that the air temperature must be between 50 and 75 degrees Fahrenheit; the relative humidity between 45 and 70 percent; the 20- foot wind speed between 5 and 25 miles per hour; wind direction from the west to southwest; and the flame length less than 4 feet. The actual prescription for a project would depend on site conditions and the objectives that are to be met. An approved prescribed fire plan is required for all prescribed fires prior to ignition.

ALTERNATIVE 1: NO ACTION (SUPPRESS ALL WILDLAND FIRES, CONDUCT LIMITED DEBRIS BURNING AND LIMITED MANUAL/MECHANICAL TREATMENT HAZARD FUEL REDUCTION)

Under this Alternative, all natural and human- caused fires in the park would be extinguished as quickly and efficiently as possible, given the constraints of safety, feasibility and minimum impact management, and using a combination of ground and aerial resources to contain the fire. Exceptions to immediate and direct fire suppression would be made on a case- by- case basis for reasons of inaccessibility, life/safety concerns for firefighters, or a lack of availability of suitable resources, personnel or equipment. There would be no use of wildland fire as a natural process (wildland fire for resource benefits), prescribed fire or hazard fuel reduction in the park. All wildland fires would be suppressed using the appropriate suppression response. Appropriate suppression would occur regardless of ignition source or location. Depending on the location and projected fire behavior, ground and/or aerial fire fighting resources would be employed to contain the fire to its smallest possible size. Ground or aerial monitoring would be conducted until the fire was mopped up (completely extinguished). All fire suppression in park wilderness would employ minimum impact suppression tactics (MIST) see Appendix 1 and Appendix 23 in the FMP. Although the intent, under this Alternative, would be to suppress all fires as quickly as possible, some fires would escape initial attack and some fires, following initial attack, could be placed in a confinement strategy, dependent on weather and fuel conditions that would enable suppression. Because of increased fuel loading not alleviated by fire, this Alternative would have increased potential to create catastrophic fires with potentially greater long- term impacts, including a greater volume of fuels burned, more smoke production (duration and particulates), and more widespread landscape changes, including to vegetation, wildlife, and cultural resources.

This alternative would not meet the goals of restoring and maintaining natural fire regimes or perpetuating natural ecosystem processes. As a result if continued suppression of naturally ignited wildland fires occurred, there could be significant changes over time to the successional conditions naturally occurring in the park. Detection of fire suppression impacts on park vegetation composition and distribution could go

unnoticed by park managers as a result of the naturally long fire return intervals (465 years on the west side of the park, 200 years on the east side). Some changes in species distribution would take centuries to manifest themselves. The past 100 years of fire suppression has likely already changed what would have been natural vegetation community characteristics in a landscape unaltered by direct fire suppression. As a result, under establishment of long- term monitoring programs, fire related changes have been identified as a key issue to investigate. To the extent that Native Americans used fire in the park and surrounding areas, these conditions have also likely been altered by unnatural fire suppression. This alternative would continue to limit the natural role of fire as an ecosystem agent of change, and in the long- term, this alternative would alter the natural composition, diversity and structure of park vegetation communities. It would also result in impacts on wildlife distribution and presence. Without systematic treatment, accumulations of forest fuels in proximity to historic structures and major developed areas would continue to present a fire hazard.

Hazard Fuel Reduction: Limited Manual/Mechanical Treatment

Manual/Mechanical Treatment would be implemented as it has been in the past in developed areas around structures and along park roads, using hand tools to periodically limb overhanging vegetation, selective removal of trees growing too close to structures, and roadside mowing/limbing and removal of fallen trees and limbs. Around structures, and along roads, the first priority would be to ensure administrative and visitor safety and protection of park resources. This includes maintaining the structural integrity of the buildings and the road prism and reducing fine fuels along roadsides to prevent fire spread, should a fire occur. Manual/Mechanical treatment is also conducted in developed campgrounds to eliminate branches and other vegetation near fire pits. Non mechanical treatment to remove dead and downed materials in developed areas and along roadsides also occurs. Roadside mowing primarily focuses on increasing visibility along park roads, including sight distance, and on maintaining the parkway like character of some park roads, but also serves, as mentioned, to reduce fine fuels along roadsides.

The maximum number of acres wherein Manual/Mechanical treatment of hazardous fuels would occur would be less than 800 acres or approximately 20 percent of the non- wilderness areas of the park per year (over five years). Treatment of this area, while it could be spread over the whole area would not be uniform. Park visitor and administrative facilities, including buildings and structures necessarily occupy a large percentage of this space and therefore the treatment area is somewhat overstated. Excluded from this estimate would be the non- wilderness area that would not be treated, including:

- the area south of the Nisqually to Paradise Road below Longmire (not adjacent to the road);
- Camp Muir;
- a small area north of the Carbon River Road (not adjacent to the road);
- and the Paradise and Sunrise meadows.

Under any projects or circumstances that would result in excess natural forest residue (defined as limbs, slash, plants and logs), the usual option is to leave these in place. Where the material cannot be left on the forest floor to undergo natural decomposition, it would be used in a variety of ways for park projects (compost, chipping, revegetation, historic structures rehabilitation, trails maintenance, campfire programs, heating public buildings). Utilization of alternative technologies for disposal, including chipping of forest residue in place, using it for revegetation or native plant nursery, or hauling it to a composting facility is also considered. Trees and limbs that fall across roads and trails would be placed back in the forest whenever this can be accomplished in a way that makes them appear natural (as discussed in Office Order 88- 1 Roadside Vegetation Management and subsequent updates). No wood or debris would be placed in surface waters. All limbs and brush cleared for health and safety reasons would be placed into the surrounding forest (away from surface waters) without further compromising safety or resource protection.

Hazard Fuel Reduction: Limited Debris Burning

There would continue to be very limited use of debris burning of forest residue to prevent accumulations of hazard fuels near historic and administrative structures. This debris is generated as a result of Hazard Fuel Reduction or road and other maintenance activities. Such debris burning would continue under certain

circumstances and only when the procedures outlined in the park's Office Order 83- 2 (Disposal of Natural Forest Residue and Manufactured Lumber) or its subsequent updates are followed. Under Office Order 83-2, the park has designed some very specific procedures to limit the disposal of wood debris by burning. These guidelines were developed to comply with current regulations from the Puget Sound Clean Air Agency (for Pierce County), the Southwest Clean Air Agency (for Lewis County), and the Washington Department of Natural Resources, to meet Clean Air Act mandates and to ensure the highest degree of protection of park air quality (as required for class I areas under the Clean Air Act).

If any of the above- described alternatives for disposal of materials from manual/mechanical treatment are not feasible, the burning of forest debris is conducted following established conditions (see Alternative 1 Air Quality Impacts). The maximum number of burn days that would occur under this alternative would be determined by air quality regulations, including the Washington State Visibility State Implementation Plan (SIP), staffing and weather conditions.

Overall, this alternative would result in the smallest expected degree of fire in the park in the short term. In the long- term, however, it could result in the most catastrophic fires. It would meet the goal of ensuring firefighter and public safety by keeping all fires as small as possible. The actual size and number of fires would depend on prevailing weather patterns, the location of lightning strikes, and the extent of fire spread before naturally extinguished (dependent on weather and fuel conditions) or suppressed. Although it would provide some protection to resources not able to withstand fire, it could result in eventual catastrophic fire, which could result in the loss of important cultural resources, including buildings and structures listed on the National Register of Historic Places. This alternative would not enable ecosystem processes to function as they have in the past millennia because all fires would immediately be suppressed. Species dependent on more frequent fire would begin to diminish over time. This would likely go unnoticed by park managers because of the extremely long fire return intervals over much of the park. Reducing hazardous accumulations of fuel in developed areas would not be undertaken systematically. Most hazardous accumulations of fuel would not be treated.

COMMON TO ALL ACTION ALTERNATIVES

DESIGNATION OF FIRE MANAGEMENT UNITS IN ALTERNATIVES 2-5

Under each of the following action alternatives, the park would be divided into two Fire Management Units as described below. In addition, the following Information, Interpretation and Education strategies would be used to increase the effectiveness of the park's enhanced fire management program (see FMP Public Safety Sections).

- The park information radio frequency (1610 AM) heard at entrance stations and Paradise would be used to inform park visitors of any significant fire activity or smoke that may impact their visit to the park.
- Information explaining fire management programs would continue to be incorporated into interpretive programs, exhibits, videos and nature walks as they are developed.
- During high fire danger, a web site will be developed which will include information about the role of fire in Mount Rainier's ecology. Web updates, including links, would be provided regularly with current information any time a fire is burning in the park.
- Articles for the summer edition of the park's visitor guide for Mount Rainier, the "Tahoma News" explaining fire management policies may be developed and made available for distribution.
- To facilitate information dissemination on a regional and national level, the park would coordinate with a number of national, regional and local agencies, including the National Interagency Fire Center.
- Maps, narrative statements and photographs of the current fire situation and fire danger ratings would be posted during high fire danger or fire operations in area ranger stations and visitor centers.
- As needed, fire information would be reported to surrounding public and private land management agencies.
- On- site visitor interpretive assistance would be initiated on all large fires, which occur near populated

or developed areas.
- Fire records, photographs, etc., important to the fire management, interpretive and research programs, would be collected and filed. Public reactions to fire management activities and interviews would be recorded and made part of the fire record.

Fire Management Units
Two fire management units have been established for Mount Rainier National Park: *suppression* and *wildland fire use* **(Fire Management Units Map)**. In both units, all human- caused fires would be suppressed and prescribed fire or hazard fuel reduction may be used to reduce unnatural fuel accumulations or to maximize return to a natural fire regime (fire return interval). In the wildland fire use unit, naturally ignited wildfires may be permitted to burn, or they may be confined, contained or suppressed, depending on the results of fire analysis. Where suppression occurs, minimum impact techniques (MIST) would be used to prevent or minimize the effects of suppression on park wilderness. The wildland fire use unit is further divided into twelve *operational areas*, within which varying fire management strategies would be employed, depending on variables present at the time of natural fire ignition. Upon a change in NPS/national wildland fire management policy, appropriate human- caused fires would possibly be considered for Wildland Fire Use.

These operational areas would be described in a future FMP operational guide and would include the specific information described below to assist fire managers in better managing park fires. Additional specific information would include: vegetation, fuel models, fuel types, fire history, values at risk/or to be protected, including historic structures, rare species habitat, aquatic resources, archeological resources, and other factors such as acceptable fire behavior and conditions. To the extent possible, the operational areas use roads, rivers, ridges, valleys, and other natural and man- made fuel breaks to form zone boundaries (**Operational Areas Map**). Adjacent lands, park facilities and ease of access were taken into consideration when designating area boundaries.

FMU – 1: Suppression Unit
In this unit, the primary goal would be to prevent or minimize the loss of historic and administrative structures by aggressively suppressing fire as it occurs and by more intensively treating the edges of developed areas, while ensuring the preservation of resources, firefighter and public safety.

Physical and Biotic Characteristics
The Suppression Unit includes the majority of park administrative facilities, including access roads and developed visitor use areas at the Nisqually and White River entrances, and the administrative/visitor use facilities at Ohanapecosh, Longmire, Paradise and Sunrise. It does not include administrative facilities at the Carbon River Entrance. Other historic structures not included in this unit are included in the Wildland Fire Use FMU as discontiguous values at risk and would be protected to the degree possible from damage or destruction.

This FMU includes a broad range of low and high elevation forest and subalpine community types, including the western hemlock, mountain hemlock, pacific silver fir and subalpine fir zones. It does not, however, include the alpine zone. Specific characteristics of the various areas within this zone are described below.

Fire Management Strategies
Hazard Fuel Reduction (including Prescribed Fire and Manual/Mechanical fuel reduction)
Where appropriate, prescribed fire and hazard fuel reduction would be used. This would include Manual/Mechanical treatment to modify fire behavior through the alteration of fuel loads, thereby reducing the threat of fire by providing a defensible space around structures.

Wildland Fire Suppression
All wildland and human- caused fires would be controlled as quickly as possible. Containment or control actions will be executed in an economical and ecologically sensitive manner to minimize the impacts of

suppression on park resources.

Strategic and measurable fire management objectives
Initial Objectives:
In addition to the objectives stated above, the following would be added:

- Facilitate the preservation of park historic buildings, structures and cultural landscapes in developed areas by conducting systematic Manual/Mechanical treatment of hazardous accumulations of fuel near these facilities. Treat 20 percent of the park per year.
- Create defensible spaces, where possible, around developed areas to provide an additional measure of protection for facilities in these areas. By 2006, identify defensible spaces around National Historic Landmark District contributing structures.
- As structures are rehabilitated, increase the use of fire suppression systems and other structural improvements that meet the Secretary of Interior's Standards for Rehabilitation of Historic Structures, resulting in no adverse effect.

Management Considerations to Operational Implementation
In the Suppression Unit (FMU – 1):
- Values at risk are not located in wilderness.
- There are a significant number of historic buildings and structures within park developed areas. These areas contain administrative infrastructure, including offices and utility systems.
- This FMU is primarily comprised of the Mount Rainier National Historic Landmark District.
- There are high concentrations of staff and/or visitors in developed and administrative facilities.
- Due to the distance from fire fighting resources, structural fire fighting is essentially limited to building fire suppression systems.
- Fire is a threat to human safety, recreational and administrative facilities, natural, historical and cultural resources.

Areas of Special Concern
The Suppression Unit (FMU –1) contains the following major park developed areas.

Nisqually Entrance Administrative Area (Nisqually Suppression Map):
The Nisqually Entrance Administrative Area, located in the southwest corner of the park, in the western hemlock zone is easily accessed via State Route 706 East. Although this area is not as well developed as other park administrative areas, there are several significant historic structures, including the Oscar Brown Cabin and Nisqually Entrance Ranger Station, and several park residences. Recently a 78,000- gallon water tank was installed to provide additional fire protection in this area. There are four fire hydrants and a maximum of 45 lbs. of pressure for firefighting. At the Nisqually Entrance, there are 10 structures [nine of which contribute to the Nisqually Entrance Historic District and the Mount Rainier National Historic Landmark District (NHLD)]. The Sunshine Point Campground, open year- round, has 18 campsites, includes picnicking and contains one restroom.

Longmire Administrative/Visitor Use Area (Longmire Suppression Map):
Longmire contains the greatest concentration of historic and residential buildings and structures in the park. There are approximately 88 total structures, of which approximately 58 are historic, including three National Historic Landmark buildings (Longmire Administration Building, Longmire Service Station and Longmire Community Building). Longmire is located approximately six miles east of the Nisqually Entrance on the Nisqually to Paradise Road in the western hemlock zone. There is also administrative/emergency access to Longmire via Forest Service Road 52 (Kernahan/Skate Creek Road) which enters the park from the south. Longmire has a year- round employee population (20 residents) and a seasonal (primarily May or June through September) resident population of 60 or more. There is a non- resident work population at

Longmire of 100+ employees in winter and about twice that in summer. Finally, Longmire contains the historic National Park Inn, with 25 guest rooms.

A small (formerly public) VIP campground and wastewater treatment plant is located across the Nisqually River from Longmire, near the Community Building. Longmire also contains a large potable water system, an historic museum, an inn and a front country nature trail (Trail of the Shadows). Approximately two miles up the Nisqually to Paradise Road from Longmire is Cougar Rock Campground, with approximately 173 sites and six structures (restrooms and ranger station) and is generally open from May until October, although some winter camping use also occurs. Longmire has 200,000 gallons of water storage capacity and approximately 90 lbs. per square inch available water pressure.

Paradise Administrative/Visitor Use Area (Paradise Suppression Map):
Paradise is approximately 15 miles east of the Nisqually Entrance on the Nisqually to Paradise Road. Paradise may also be accessed from May until October or November via the Stevens Canyon Road from State Route 123. There is currently a one- way exit from Paradise via the Paradise Valley Road that ends at the Stevens Canyon Road. Paradise, located in the pacific silver fir zone, contains approximately 21 structures, of which approximately seven contribute to the Paradise Historic District and the Mount Rainier NHLD, including the Paradise Inn National Historic Landmark Building, the Skyline Trail and the Paradise Guide House. Paradise is home to the approximately 40 seasonal residents and the seasonal Paradise Inn, with approximately 117 rooms. A major potable water system, wastewater treatment plant, large picnic area and the park's main visitor center are also located at Paradise. Based on parking, there are two distinct visitor access areas at Paradise – the upper and lower parking lots. Paradise provides hiking and climbing access to the upper Mountain, especially Camp Muir. Paradise has 250,000 gallons of water storage and approximately 85 lbs. per square inch available water pressure.

White River Entrance Administrative Area (White River Suppression Map):
The White River Entrance provides public and administrative operations, including fee collection, public restroom facilities, wilderness information, backcountry ranger office, and maintenance and ranger housing. This historic entrance to the park was recognized in the White River Entrance Historic District, which includes the Ranger Station, the men's and women's comfort stations and the mess hall/dormitory. The White River Ranger (Entrance) Station was built in 1929 by the NPS and the Mess Hall/Dormitory was built either for, and/or by the Civilian Conservation Corps in 1933. The White River fee booth was constructed much later. These facilities are essential to ensuring NPS administrative operations in the White River developed area of Mount Rainier National Park. Visitors using the White River facilities may be day- use visitors (White River/Sunrise Area), overnight backcountry visitors (Wonderland Trail, etc.) or overnight campers (112- site/6 restrooms White River Campground). The White River area is located in the silver fir/mountain hemlock zone. Within this intermediate forest, the vegetation is dominated by the Silver fir (*Abies amabilis*)/Alaska huckleberry (*Vaccinium alaskaense*) vegetation type. This vegetation association is the most extensive type in Mount Rainier National Park. The White River Entrance has approximately 20,000 gallons of water storage and approximately 10 lbs. per square inch available water pressure.

The silver fir/Alaska huckleberry vegetation type is the most extensive in the park. Mature forests of this type lack temperature and moisture extremes and are comprised primarily of western hemlock, silver fir and Douglas- fir. Alaska yellow cedar (*Chamecyparis nootkatensis*) and noble fir (*Abies procera*) are also common. Common understory shrubs include huckleberry (*Vaccinium sp.*), Oregon grape (*Berberis nervosa*), salal (*Gaultheria sp.*), etc. Common forbs include vanilla leaf (*Achlys triphylla*), trillium (*Trillium ovatum*), wood sorrel (*Oxalis oregana*), false Solomon's seal (*Smilacina racemosa*), bead lily (*Clintonia uniflora*), anemone (*Anemone deltoidea*), etc. Common ferns include sword fern (*Polystichum munitum*), deer fern (*Blechnum spicant*) and others. As with any forested area in the northwest, a wide variety of mosses, fungi and lichens are also abundant.

Ohanapecosh Administrative/Visitor Use Area (Ohanapecosh Suppression Map):

The Ohanapecosh area is located in the pacific silver fir/western hemlock zone and is dominated by the following tree associations at low elevations, such as are present in the Grove of the Patriarchs). Silver fir/devil's club, silver fir/Alaska huckleberry (including the Oregon grape phase), western hemlock/vanilla leaf, western hemlock/devil's club, and western hemlock/salal plant associations. Ohanapecosh contains a visitor center, administrative facilities (including a ranger station, housing, and maintenance area), and a large campground with 205 sites and seven restrooms, including several historic restrooms. Ohanapecosh has 50,000 gallons of water storage and approximately 100 lbs. per square inch available water pressure.

The Grove of the Patriarchs is an excellent example of a streamside community long- protected from fire (Franklin *et al.* 1988). Some of the trees in the Grove and beyond (near the confluence of Chinook Creek and the Ohanapecosh River) are estimated to be over 1000 years old. The largest trees are western red cedar, western hemlock and Douglas- fir. In addition, this diverse forest contains subalpine fir (*Abies lasiocarpa*), Pacific silver fir (*Abies amabilis*), Alaska yellow cedar (*Chamaecyparis nootkatensis*) and red alder (*Alnus rubra*). Shrubs include vine maple (*Acer circinatum*), salal (*Gaultheria shallon*), elderberry (*Sambucus racemosa*), salmonberry (*Rubus spectabilis*), huckleberry (*Vaccinium sp.*), beaked or California hazelnut (*Corylus cornuta*), and thimbleberry (*Rubus parviflorus*), etc. Forbs include western tea- berry (*Gaultheria ovatifolia*), skunk cabbage (*Lysichiton americanum*), bead lily (*Clintonia uniflora*), vanilla leaf (*Achlys triphylla*), twinflower (*Linnaea borrealis*), violets (*Viola sp.*), five- leaved bramble or trailing raspberry (*Rubus pedatus*), foam flower (*Tiarella trifoliata*), miner's lettuce (*Claytonia perfoliata*), bleeding heart (*Dicentra formosa*), stinging nettles (*Urtica dioica*), pathfinder (*Adenocaulon bicolor*), trillium (*Trillium ovatum*), and wild ginger (*Asarum caudatum*), etc. Ferns include bracken fern (*Pteridium aquilinum*), lady fern (*Athyrium filix- femina*), oak fern (*Gymnocarpium dryopteris*), sword fern (*Polystichum munitum*), maidenhair fern (*Adiantum pedatum*), etc. There are also a wide variety of mosses, liverworts and lichens.

Sunrise Administrative/Visitor Use Area (Sunrise Suppression Map):
The Sunrise area, located within the subalpine fir zone, contains historic administrative and public use facilities, including approximately 15 historic structures and buildings including overlooks, a picnic area, the Sunrise Stockade Complex (also a National Historic Landmark building), and the Sunrise Lodge. Sunrise also contains some park housing, a visitor center, a large septic system, a potable water system and a large generator. Sunrise has available water storage (Frozen Lake) ranging from a low of 500,000 gallons to a high of one million gallons and approximately 120 lbs. per square inch of available water pressure.

Sunrise vegetation is a mosaic of tree clumps and herbaceous meadows. Tree clumps are dominated by subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*) and white bark pine (*Pinus albicaulis*). Herbaceous meadows are composed of a mosaic of dry grass and heath- shrub vegetation communities (Henderson 1973). Dry grasses are the most common, and are dominated by green fescue (*Festuca viridula*), lupine (*Lupinus latifolius*), paintbrush (*Castilleja sp.*), and asters (including *Aster alpigenus* and *A. ledophyllus*). Heath- shrub vegetation is found in moister sites and is dominated by white heather (*Cassiope mertensiana*) and red heather (*Phyllodoce empetriformis*).

Tahoma Woods Administrative Headquarters Area (Tahoma Woods Suppression Map):
Tahoma Woods, located between Elbe and Ashford (approximately 3 miles from each) is the park's administrative headquarters, containing administrative operations, including the office of the superintendent, budget, personnel and other administrators in one structure. Nearby are 15 (3- bedroom) houses, a greenhouse, a maintenance storage area, and an air quality monitoring station. Also proposed for this site are two 8- unit apartment buildings and an education center and a natural and cultural resources office complex. Tahoma Woods has 150,000 gallons of water storage and approximately 45 lbs. per square inch of available water pressure.

Tahoma Woods is located in the western hemlock zone, which is characterized by thick forests of western hemlock, western red cedar and Douglas- fir. Deciduous species include: red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*) and bigleaf maple (*Acer macrophyllum*). Common understory shrubs include: vine maple (*Acer circinatum*), Oregon grape (*Berberis sp.*), red huckleberry (*Vaccinium parvifolium*),

devil's club (*Oplopanax horridum*), salal (*Gaultheria shallon*), red- flowering currant (*Ribes sanguineum*), etc. Common forbs include: vanilla leaf (*Achlys triphylla*), trillium (*Trillium ovatum*), wood sorrel (*Oxalis oregana*), false Solomon's seal (*Smilacina racemosa*), bead lily (*Clintonia uniflora*), spotted coralroot (*Corallorhiza maculata*), anemone (*Anemone deltoidea*), bunchberry dogwood (*Cornus canadensis*), miner's lettuce (*Montia sibirica*), inside- out flower (*Vancouveria hexandra*), etc. Common ferns include sword fern (*Polystichum munitum*), deer fern (*Blechnum spicant*), bracken fern (*Pteridium aquilinum*), etc. As with any lowland forest, a wide variety of mosses, fungi and lichens are also abundant. Despite the fact that Tahoma Woods is second growth (having been logged in the 1800s and 1960s while owned by Weyerhaeuser Company prior to its purchase by the National Park Service). The forest is relatively intact, containing a wide variety of understory species and a diverse array of wildflowers in season. Interspersed at Tahoma Woods is a cultivated lawn of perennial rye and red fescue bisected by gravel and asphalt driveways, roads and parking.

FMU 2— Wildland Fire Use For Resource Benefits Unit

The purpose of the wildland fire use unit is to encourage fire as a natural disturbance that results in a landscape mosaic of varying species composition and structure. Dependent on variable analysis at the time of fire occurrence, naturally ignited wildland fires will be allowed to burn, confined, contained, controlled or suppressed. As with the Suppression Unit, all human- caused fires would be immediately suppressed. In addition, similar to the Suppression Unit, prescribed fire and hazard fuel reduction strategies would be used to sustain a natural fire regime.

Strategies

- Manage the FMU to maximize wildland fire presence to the fullest extent possible while protecting values at risk.
- All unwanted wildland fires would be suppressed using the appropriate fire suppression response options, dependent upon the Wildland Fire Implementation Plan (WFIP) (FMP Appendix 17).
- All naturally occurring fires within this unit would be reviewed for appropriate classification and management response. A Wildland Fire Situation Analysis (WFSA) (FMP Appendix 20) would be completed for each ignition and the fire would be declared either for Wildland Fire Use or appropriate suppression. This fire- by- fire analysis and decision process gives managers a range of options to manage fires.
- Some fires may need to be suppressed, while others may only be managed on a specified flank to limit spread into a certain area. Fires not suppressed and allowed to play out a natural role in the environment will be monitored daily to gain knowledge and data on fire behavior and ecological effects, as well as to keep a close watch on fire activity. A daily validation of current and expected fire behavior and analysis of the continuation of ongoing fire management strategies as part of the WFIP would be completed. If a natural wildland fire exceeds the prescription at any time it shall be declared a wildfire and appropriately suppressed.
- Where necessary to meet fuel reduction objectives, approved fuels management techniques, including prescribed fire would be used to modify localized fuel concentrations leading to fire behavior more conducive to fire suppression tactics.

Management Considerations to Operational Implementation

- This FMU is primarily comprised of wilderness.
- A number of backcountry historic buildings, including four fire lookouts, eight cabins, and three shelters, as well as more than 50 historic structures are part of the National Historic Landmark District and are included in this FMU. The historic structures include bridges, overlooks, culverts, tunnels, roads, trails, monuments and dams.
- This FMU includes minor developed areas such as Mowich Lake, Carbon River Entrance, Ipsut Creek Campground, Reflection Lakes, Tipsoo Lake, Box Canyon, Narada Falls, Ricksecker Loop Road, etc.
- Potable and non- potable water delivery systems, as well as other park utility systems, that service park

developed areas are included in this unit.

- The islands of park developed areas that comprise FMU – 1, the Suppression Zone, are encompassed by this FMU.
- There are several major roads that access various portions of this Zone; however, most access is via trail.
- There are a number of known and unknown rare, threatened and endangered species issues in this FMU.

Physical and Biotic Characteristics

Elevations range from 1,600 feet to 14,410 feet. The area above 7,000 feet, however, is primarily snow, rock and ice and is of little concern from a wildfire perspective. Topography ranges from low elevation river valleys to alpine areas and contains deep valleys and numerous peaks. Nine major rivers cut through or border this zone. Annual precipitation may be up to and over 100 inches, falling primarily as rain below 5,500 feet and as snow above. Historically, the highest incidence of recorded lightning fires has occurred in this unit between 4,500 and 5,500 feet. This FMU includes a broad range of low and high elevation forest and subalpine community types, including the Western Hemlock, Mountain Hemlock, Pacific Silver Fir, Subalpine Fir, and Alpine generalized vegetation types.

Access to FMU – 2 is provided by State Highways 123 and 410, the Westside Road, Nisqually to Paradise Road, Stevens Canyon Road, White River- Sunrise Road, Carbon River Road, and the Mowich Lake Road but would primarily be accessed via designated trails and cross- country travel.

ALTERNATIVE 2: WILDLAND FIRE SUPPRESSION AND WILDLAND FIRE USE FOR RESOURCE BENEFITS

Under this Alternative, all unplanned human- caused fires would be immediately suppressed as described in Alternative 1 (both FMUs), however naturally ignited (lightning/volcanic) wildland fires would either be allowed to burn under certain conditions or would be extinguished in FMU 2. The ability to use naturally ignited wildland fire in FMU 2 would depend on individual Wildland Fire Situation Analysis (WFSA) to determine whether the wildland fire met certain pre- determined parameters for fulfilling resource objectives (benefits). To use this strategy, the fire manager, in consultation with an interdisciplinary team, would determine that a natural wildland fire start would provide resource benefits if managed under specific conditions within a maximum manageable area (MMA). This strategy would then be used to incorporate suppression "holding" actions on sections of the fire perimeter to keep the fire within the predetermined MMA, while allowing other natural features to check the spread of the fire on other perimeters within the MMA. Dependent on fire location, size, spread, resource values at risk and other factors, management of wildland fire use requires a variety of actions that could include keeping the fire out of heavy fuels if they produce too much smoke, keeping it away from sensitive resources, keeping it from burning buildings, etc.

The park's fire history shows the largest recent human- caused fire within the park to have been a road clearing fire that escaped and burned 11,000 acres in the 1930s. Ancient fire history (**Table 1**), however, shows fire episodes (based on tree ring analysis and other factors) of up to 61,750 acres. Excepting that, large fires have been in the range of 2,500 to 11,000 acres, and most fires have been on the order of 1,000 acres or less. Finally, the most frequent fires are much smaller, on the order of 1- 5 acres or less. Early park documents (Allen 1922) also attest to burning of some park landscapes by Native Americans. Allen suggests that Mount Rainier lands were burned by Indian people to make them more accessible and to improve huckleberry and game habitat (*See also Fire History section below*). Therefore, it is reasonable to assume that unless regional weather patterns precipitated extremely large catastrophic fires (that under any scenario would likely be difficult to contain or control), that the fire management strategies employed in this plan, including Fire Suppression, Wildland Fire Use, and Prescribed Fire, would primarily result in a large number of fires less than 5 acres, some fires up to 2,500 acres, and a few fires between 2,500 and 11,000 acres. The actual size and number of fires would depend on prevailing weather patterns, the location of lightning strikes, and the extent of fire spread before naturally extinguished (via weather conditions or fuel breaks or discontinuities) or suppressed.

Potential Wildland Fire Use For Resource Benefits, as defined in the Natural Resources Management Guideline (NPS 1992, 2:212- 213), include Wildland Fire Use of fire to:

- restore or maintain natural ecosystems;
- influence natural successional patterns;
- restore or maintain an historic scene (including cultural and traditional cultural landscapes);
- restore or maintain vistas;
- reduce fuels which contribute to a wildfire hazard;
- create fuel breaks near developments or the park boundary;
- enhance the habitat of sensitive species;
- control exotic species.

Determining the potential for Wildland Fire Use is complex and based on Wildland Fire Situation Analysis (WFSA) (Appendix 20) and the Wildland Fire Implementation Plan (WFIP) (Appendix 17). Under these analyses, specific resource benefits would be defined prior to the Wildland Fire Use.

A lightning caused fire in FMU 2 would be suppressed if:

- it did not meet every element of the Decision Criteria Checklist;
- long or short- term drought conditions were evident;
- it would exceed management capability to implement the WFIP;
- the fire is projected to burn toward the park boundary, when the adjacent landowner will not/cannot accept management of the fire;
- No resources are available for management of Wildland Fire Use;
- The superintendent or designated acting superintendent will not approve the WFIP for Wildland Fire Use; or
- The regional fire management officer, with concurrence from the superintendent, determines that regional and/or national conditions outweigh the potential benefits of the fire, and therefore appropriate fire suppression action is warranted.

Wildland Fire Use would be limited to stand replacing fires in less than 10 percent of known suitable habitat for northern spotted owls or marbled murrelets, with an allowance for an additional acreage, not to exceed 15 percent of suitable habitat in any 100 year period. Fast moving (non- stand replacing fires) could exceed this acreage, but increased monitoring of impacts to these species would result. Typically, the park experiences a low frequency of lightning ignitions (approximately eight per year between 1987 and 1997). Lightning caused fires in the FMU 2 that had the potential to exceed these acreage limitations would be considered candidates for Wildland Fire Use only with additional environmental analysis and consultation with the USFWS.

As with Alternative 1, all fire suppression in park wilderness would employ minimum impact suppression tactics (MIST), BMPs and mitigation strategies as described in Appendix 1 and throughout the impacts analysis section (*Environmental Consequences*) of this Environmental Assessment. Fire suppression in developed areas would also be confined to best management practices that would not result in degradation or loss of park resources. There would be no use of prescribed fire or hazard fuel reduction in either Fire Management Unit under this Alternative.

ALTERNATIVE 3: WILDLAND FIRE SUPPRESSION RESPONSE, WILDLAND FIRE USE FOR RESOURCE BENEFITS, AND PRESCRIBED FIRE

This Alternative would be the same as Alternative 2, but would also incorporate the use of prescribed fire to:

- reduce hazardous fuel accumulations around structures (FMU 1 and 2);
- reduce hazardous fuel accumulations adjacent to private lands or other public lands where cross-boundary fire would be unacceptable (FMU 2 only); and to

- restore fire to vegetation communities, as determined under a pre- determined scientific need to meet resource objectives (FMU 1 and 2).

Prescribed Fires are planned, scheduled, organized and implemented according to a rigorous protocol. Their purpose is safe accomplishment of predefined resource benefit objectives. Escaped Prescribed Fire, as well as Wildland Fire Use that exceeded appropriate prescriptions would be managed under a Fire Suppression strategy, regardless of whether they returned to prescription. Prescribed fire plans are now required to undergo agency peer review as well as individual environmental analysis (including public review). As prescribed fire plans are developed, the park would likely conduct environmental analysis for a multi- year prescribed fire action plan, rather than assessing each prescribed fire separately.

As envisioned, Prescribed Fires could be used to:

- maintain scenic vistas;
- maintain fire dependent plant communities;
- maintain some boundary areas (where cross- boundary fire was unacceptable);
- manage sensitive resource areas that would need to have cooler fires with lower intensities to prevent damage to the resource at risk;
- restore cultural or traditional landscapes; and to
- reduce hazard fuel accumulations near developed areas, etc.

Prescribed Fires would include measurable criteria (the prescription) to define the specific environmental conditions under which park managers would ignite a fire. Prescription criteria include weather conditions (current and forecast), description of the prescribed fire project boundary, appropriate holding force availability, fire starting techniques and timing. These prescription criteria would help to ensure that the fire remained within a pre- designated perimeter without threatening life or property and met resource objectives. To the extent possible, Prescribed Fire (as well as Wildland Fire Use) implementation would:

- use natural barriers rather than constructed fire lines to prevent fire spread and to minimize consequent impacts to soils and other park resources;
- minimize up and down slope fireline construction;
- utilize controlled burn intensities to result in a fast- moving, lower temperature impact fire; and
- require post- fire rehabilitation of fire lines, including efforts to reduce compaction by scarifying the soil, and installing natural erosion barriers.

Although there are currently no plans to conduct Prescribed Fire within Mount Rainier National Park, under future implementation of the FMP, such a plan would be written and separate environmental analysis would be conducted for each series of proposed Prescribed Fires. The most likely areas that would be targeted for Prescribed Fire would be the whitebark pine community and potential research burns in forested or subalpine communities. Other Prescribed Fire use might include establishing a very limited, but more frequent fire regime around developed areas where great concentrations of important historic structures are located, such as at Longmire and Paradise. Finally, Prescribed Fire might also be used to ensure that fire did not cross the park boundary where the adjacent landowner was unwilling to accept or unable to manage wildland fire.

ALTERNATIVE 4: WILDLAND FIRE SUPPRESSION, WILDLAND FIRE USE FOR RESOURCE BENEFITS, AND HAZARD FUEL REDUCTION (Debris Burning and Manual/Mechanical Treatment)

This Alternative would be the same as Alternative 2, but would incorporate the use of hazard fuel reduction (Debris Burning and Manual/Mechanical treatment) in FMU 1 to reduce hazard fuel accumulation around historic buildings and structures and other sensitive cultural and administrative resources needing protection from unacceptable wildland fire effects.

This Alternative would also add appropriate Manual/Mechanical treatment (under Minimum Tool Guidelines) to reduce hazard fuel accumulations surrounding wilderness cabins and shelters in FMU 2. Hazard Fuel Reduction in wilderness to protect historic buildings, however, would be minimal and would rely, to the degree possible, on non- mechanized equipment. This would primarily consist of trimming overhanging limbs in contact with the structure and creating a defensible space around the structure. As with other Alternatives, all fire suppression in park wilderness would employ minimum impact suppression tactics (MIST) and debris burning in wilderness would conform to controlled conditions, be conducted in designated areas near historic structures and be similar to large campfires.

To the degree possible, a variety of methods to dispose of hazard fuels would be used. These methods would include dispersing cut vegetation immediately back into forested areas surrounding developed areas (a common practice along roadsides); broadcast chipping of cut vegetation through the area treated; etc. To limit air quality impacts, pile burning would be used as a last resort and only under specified controlled conditions.

The use of mechanized and other equipment to create defensible clear spaces around structures, primarily in FMU 1, but also as appropriate in FMU 2 would result in a small degree of protection for park cultural resources. This degree of protection would increase the probability that these structures would withstand wildland fire. It is important to note, however, that many of the park's historic structures are of wood construction with cedar shake roofs, and lack internal fire protection systems or alarms and as a result are not considered defensible structures. In addition, structural fire response times vary with distance from the park administrative headquarters at Longmire, where emergency services are concentrated. Recently, however the park has upgraded the capacity of its water storage systems and increased the number of fire hydrants in some park areas, such as the Nisqually and White River entrances. Future similar upgrades would also likely occur.

The degree of Fire Suppression and Wildland Fire Use would be the same as under Alternative 2. The degree of Hazard Fuel Reduction would be enhanced and systematic (and would adhere to the **Hazard Fuel Reduction and Cultural Resources Maintenance Program**). It would therefore be more comprehensive than as described under Alternative 1 but would encompass a similar sized area – approximately 20 percent of the park per year or about 800 acres on a five- year rotation.

ALTERNATIVE 5: WILDLAND FIRE SUPPRESSION, WILDLAND FIRE USE FOR RESOURCE BENEFITS, PRESCRIBED FIRE AND HAZARD FUEL REDUCTION (MANUAL/MECHANICAL FUEL REDUCTION AND DEBRIS BURNING) (PREFERRED/ENVIRONMENTALLY PREFERRED)

Under this Alternative, all fire management strategies would be used as described above. This Alternative would be similar to Alternative 4, but would include the same Prescribed Fire management described in Alternative 3.

As with other alternatives, all human- caused fires would continue to be suppressed in both FMUs unless there was a change in NPS/national policy wherein some human- caused fires under appropriate conditions could be allowed for Wildland Fire Use. All fire suppression in park wilderness would employ minimum impact suppression tactics (MIST). Lightning caused wildland fires, occurring in FMU 2, would be analyzed to determine whether they would meet prescriptions that would result in resource benefits. Fires would also be analyzed to determine if they would pose unacceptable risks to life, safety, private property or natural or cultural resources that cannot be mitigated with the resources available. If naturally ignited fires did not meet these established conditions, they would also be suppressed. In addition, management ignited wildland fires (prescribed fire) would be used in both FMUs as appropriate to achieve desired resource management or research objectives, including the reduction of hazardous fuel accumulations from previous fire suppression activities, and/or to help create defensible clear spaces around historic structures. As with other alternative effects' analyses in this Environmental Assessment, this Alternative would result in the greatest degree of management flexibility in the appropriate application of wildland fire management

strategies over the park landscape. As a result, this Alternative would have the potential to elicit the best integration or combination of strategies in a way that would cause the least possible adverse effects to park resources. It would result in comprehensive accomplishment of the fire management objectives outlined earlier.

VII. ALTERNATIVES CONSIDERED BUT REJECTED

1) No Management

Under this alternative, all fires would be permitted to burn freely. No wildland fire suppression, wildland fire use for resource benefits, hazard fuel reduction or prescribed fire would be employed. This alternative was rejected because it contradicts NPS mandates and policy regarding human safety and resource protection. This alternative would not meet the goals of ensuring public safety as the highest priority, protecting cultural resources, or reducing hazard fuel accumulation. This would not protect sensitive resources that could not withstand the effects of wildland fires, such as endangered species. Additionally, it would result in the alteration of natural fire regimes near roads, structures, utilities and camps where there is an unnatural concentration of human- caused ignitions.

2) All alternatives which did not include wildland fire suppression, including:

- only prescribed fire
- only hazard fuel reduction
- only wildland fire use

and any combinations of these without wildland fire suppression were rejected. Losing the ability to appropriately suppress wildland fires would jeopardize health and safety, facilities, and natural and cultural resources not able to withstand wildland fire.

3) Wildland Fire Suppression and Hazard Fuel Reduction

This alternative was rejected for the same reason as described above. Suppressing all wildfires and using only hazard fuel reduction without the use of wildland fire for resource benefits or prescribed fire would not meet NPS resources preservation mandates or the purposes of the fire management program, since there would be no way to return fire as a natural ecosystem process. This alternative, therefore, would not meet one of the primary goals of the park fire management program.

4) All alternatives, which did not include wildland fire use for resource benefits, were also rejected, including:

- Wildland Fire Suppression Response, Prescribed Fire And Hazard Fuel Reduction, and
- Wildland Fire Suppression Response and Prescribed Fire

This alternative would consist of using prescribed fire to replicate the effects of naturally ignited wildland fire. Although an aggressive prescribed fire program could take the place of naturally ignited wildland fire use for resource benefits, it would have to be based on the historical and future occurrence of natural wildland fire starts. Since prescribed fire involves the use of management ignited fire under very specific (usually cooler) conditions, prescribed fire would result in different fire effects than the use of naturally ignited wildland fire. There would also still be some conditions under which prescribed fire would not be initiated, but wildland fire use could still be considered, therefore this would only partially restore fire as a natural process. The process of completely replacing the natural role of fire would result in substantial human interference in wilderness. This interference would manifest itself in two ways: 1) intrusion to suppress natural fires and 2) intrusion to ignite prescribed fires. Fire behavior and effects are known to vary with terrain, vegetation, fuels, cumulative weather conditions, and season. With site specific information about how these variables interact, the probabilities of fire ignition, fire spread and fire behavior can be projected. It is not possible to determine, however, how a given fire would have unfolded, nor is it possible to duplicate the original conditions. As a result, prescribed fires would only approximate the effects of natural fires. Replacing all fires with prescribed fire would alter natural ecosystem processes and contradicts one of the primary objectives of the park's fire management program.

5) Fuel Break Construction along boundary without adjacent wilderness or late successional reserves

This alternative was rejected because of the unreasonably high cost, environmental impacts, and intrusions into the wilderness that would result from constructing fuel breaks along the park boundary. It would be

cost prohibitive to implement this alternative due to the length of the boundary, difficult access to many boundary areas, and heavy fuels. Construction of fuel breaks would affect threatened species habit by altering vegetation within the fuel breaks. Of equal concern would be the noise impacts from helicopters, chainsaws, and other equipment necessary to accomplish this project. The resulting fuel breaks could be expected to slow, but not stop the spread of low to moderate intensity fires across the boundary. Fuel breaks would be less effective in stopping high intensity fires that reach the tree crowns because sparks from crown fires are commonly thrown long distances. Recent research indicates that fire losses are more closely tied to the ignitability of structures and their immediate surroundings - within tens of meters of structures – rather than to the ignitability of the extended landscape. Construction of miles of fuel breaks along the boundary would be prohibitively expensive, and would result in unacceptable environmental impacts.

6) Fire Suppression Zone along West Boundary and other similar boundary areas

This alternative was rejected based on the desire to enable natural ecosystem processes to function parkwide. A suppression zone along the west boundary would be difficult to maintain and would have questionable effectiveness in preventing fire occurrence for some of the same reasons as described above in fuel break construction.

VIII. IMPACT TOPIC ANALYSIS

Impact Topics

Specific impact topics were developed to address potential natural, cultural, recreational and park operations impacts that might result from the proposed Alternatives as identified by the public, NPS, and other agencies, and to address federal laws, regulations and orders, and NPS policy. A brief rationale for the selection of each impact topic is given below. Adverse impacts on these resources would be avoided, minimized or mitigated.

Air Quality: The Clean Air Act requires federal land managers to protect air quality, while the NPS Management Policies (2001) address the need to analyze air quality during park planning. Mount Rainier National Park is a mandatory Class I air quality area under the Clean Air Act. This designation allows for minimal air quality deterioration. The Clean Air Act states that managers have an affirmative responsibility to protect park air quality related values (including visibility, plants, animals, soils, water quality, cultural resources and visitor health) from adverse air pollution impacts. In addition, the National Environmental Policy Act (NEPA) requires the analysis of impacts on all affected components of the human environment (including natural, cultural and social impacts).

Soils: Management Policies (NPS 2001) require the NPS to understand and preserve and to prevent (to the extent possible) the unnatural erosion, physical removal, or contamination of the soil. Special Directive 91- 6 also requires consideration of impacts to topography and soils.

Special Status Species and Habitats: The Endangered Species Act requires an examination of impacts to all federally listed threatened or endangered species. Management Policies (2001) and the Natural Resources Management Guideline (1993) also require an analysis of impacts to state- listed threatened or endangered species and federal candidate species. Under the ESA, the NPS is mandated to promote the conservation of all federal threatened and endangered species and their critical habitats within the park boundary. Management Policies includes the additional stipulation to conserve and manage species proposed for listing. Ongoing informal consultation with the U.S. Fish and Wildlife Service and Washington Department of Fish and Wildlife has identified several important rare, threatened and endangered species that occur in Mount Rainier National Park.

Vegetation and Wildlife including Natural Ecosystem Processes: As mentioned, NEPA calls for examination of the impacts on the components of affected ecosystems. NPS policy is to protect the natural abundance and diversity of park native species and communities, including minimization of potential impacts from proposed projects. Wildland fire is an important component of overall ecosystem health. The fire management program should promote strategies that enhance or allow natural fire processes and minimize strategies that interfere with natural fire processes.

Water Quality/Quantity: Section 401 of the Clean Water Act, potential impact to endangered species listed under the Endangered Species Act, as well as Management Policies (2001) and the Natural Resources Management Guideline (NPS 1999) requires analysis of impacts on water.

Wetlands: Executive Order 11990 requires that impacts to wetlands be addressed.

Floodplains: Executive Order 11988 requires that impacts to floodplains be addressed.

Archeology, Ethnography, Historic Structures, Cultural Landscapes: The National Historic Preservation Act (NHPA) (16 USC 470 *et seq*. as amended); NEPA; *Cultural Resources Management Guideline* (NPS 1994); and Management Policies (NPS 2001) require the consideration of impacts on cultural resources listed on or eligible for listing on the National Register of Historic Places. In 1997, much of the non- wilderness portion

of Mount Rainier National Park was enveloped in the Mount Rainier National Historic Landmark District. The District was designated because the park is the best and most intact example of NPS master planning dating from the early 20th century. In addition to developed area structures, the Wonderland and Northern Loop trails are also part of the NHLD. Five architecturally significant historic districts were designated in Mount Rainier National Park prior to the comprehensive NHLD. Although the historic districts are enveloped by the NHLD, they remain separately listed on the National Register of Historic Places for their architectural significance. The actions described herein are also considered "undertakings" under Section 106 of the NHPA and are therefore required to be analyzed. The Archeological Resources Protection Act requires the protection of presently identified or undiscovered archeological resources. Native Americans may have played a role in the historic fire regime. Prescribed fire can be considered a tool to mimic historic fire patterns on traditionally managed landscapes.

Wilderness: Ninety- seven percent of Mount Rainier National Park is designated wilderness. The Wilderness Act requires an examination of proposed projects for their potential impacts to wilderness character and values. Projects that may affect wilderness are reviewed for their necessity with respect to administration of wilderness, their consistency with wilderness designation, as well as with respect to the use of the minimum tool (See Environmental Assessment Appendices 2 and 1 and Fire Management Plan Appendix 30). Management Policies (2001) and NEPA (with respect to land use designations) also require assessment of effects on wilderness.

Visitor Experience: A range of impacts to the visitor experience would result from the implementation of various fire management strategies, including potential changes in visitor services and closures of trails, park areas and roads.

Park Operations and Visitor Services, including Protection of Life and Property: NEPA and Management Policies (2001) call for an assessment of the effects of proposed projects and plans on the human environment, and to park operations and visitor services, respectively. Fire management programs may affect scenic values, visitor use activities and the ability to visit a park or parts of a park. The NPS mission also addresses the need to provide for the enjoyment of future generations and is an important consideration in all NPS decision making. In addition, Management Policies identifies the assessment of actions with respect to human health and safety. Fire management programs require cooperation with other land management agencies and local governments. Wildland and prescribed fires have the potential to escape into surrounding lands. Early and consistent coordination with park neighbors, local fire jurisdictions, neighboring landowners and Native Americans is part of a fire management program.

Environmental Justice in Minority and Low- Income Populations: Executive Order 12898: "General Actions to Address Environmental Justice in Minority Populations and Low- Income Populations" requires Department of Interior Agencies to analyze and evaluate proposals with respect to the impacts on these populations. Although none of the alternatives herein would differentially affect minority or low- income populations, there have been cumulative effects on Native American Tribes due to habitat modification resulting from fire suppression.

Socioeconomics: Fires and firefighting often have a wide variety of ramifications, including temporary spikes in local economies when large catastrophic fires occur, therefore this topic is included.

Impact Topics Dismissed from Further Consideration

Other impact topics mandated by law or executive order, or that are of public interest, have been dismissed from further consideration because impacts may be non- existent or minor.

Geological Processes and Hazards: The National Environmental Policy Act (NEPA) requires the analysis of impacts on all affected components of the human environment (including natural, cultural and social impacts). Analysis of geological processes and hazards is also required under Management Policies (2001).

Based on the subject of this Environmental Assessment, no potential impacts to geological processes or their resultant hazards would occur.

IX. AFFECTED ENVIRONMENT

General Description of the Park

Mount Rainier National Park is comprised of 235,625 acres in west central Washington, on the western slope of the Cascade Range. Eighty three percent (196,181 acres) of the park lies in Pierce County and 17 percent (39,444 acres) is in Lewis County. The park's northern boundary is approximately 65 miles southeast of the Seattle- Tacoma metropolitan area and 65 miles west of Yakima (**see Adjacent Lands Map**). The elevations of the park range from about 1,400 feet above sea level at the Tahoma Woods Administrative Site to 14,410 feet at the summit of Mount Rainier.

The focal point of the park is the towering, snow and ice- covered volcano, a prominent landmark in the Pacific Northwest. The base of the volcano spreads over an area of about 100 square miles. Mount Rainier is the second most seismically active and most hazardous volcano in the Cascade Range. The 26 major glaciers that flank the upper mountain cover 35 square miles. Below, steep glaciated valleys, and ice carved peaks dominate the park landscape. The Carbon, Mowich, White, West Fork White, Nisqually, South Puyallup, and North Puyallup rivers and their tributaries carry water from Mount Rainier to the Puget Sound. The Ohanapecosh flows into the Cowlitz River and on into the Columbia River. Over 470 mapped rivers and streams, 382 mapped lakes and ponds, and more than 2,500 acres of wetlands, numerous waterfalls and mineral springs characterize this park in the Cascades.

Mount Rainier's scenic landscapes – including the dense lower old- growth forests, the magnificent display of subalpine wildflowers, and the mountain itself – have attracted people for generations. The mountain is a destination for snow and ice climbers throughout the world. About 2.0 million people visit the park annually, with most visitation (75 percent) occurring between June and September.

Park vegetation is diverse, encompassing three ecological zones. Above tree line (around 7,000 feet) and comprising approximately 19 percent of the park is the alpine zone, generally consisting of snow, ice, rock and fragile alpine plants. From about 5,000 feet to tree line and covering about 23 percent of the park is the subalpine zone, characterized by scattered stands of subalpine fir, heather and grass meadows. Below the subalpine lies the forest zone, occupying about 58 percent of the park and dominated by western hemlock, silver fir, Douglas- fir, western red cedar and other species.

In addition to its natural wonders, the national park has a long history of human activities. The area was used by Native Americans for hunting and gathering, as well as for spiritual and ceremonial purposes. In the early 20th century miners, climbers, and tourists, among others, came into the area. The establishment of the park, and subsequent planning and development for visitor use and landscape protection constitutes an important chapter in the development of the American park idea. As a result, the park has rich and diverse cultural resources, including prehistoric and historic archeological resources, historic structures and cultural landscapes.

At least five federally recognized tribes have traditional association with Mount Rainier:

1) Muckleshoot Indian Tribe
2) Puyallup Tribe of Indians
3) Cowlitz Indian Tribe
4) Nisqually Indian Tribe, and the
5) Yakama Indian Nation

Important treaties include the Treaty with the Yakama (1855), the Treaty of Medicine Creek (1854), and the Treaty of Point Elliot (1855). Also of note is the presence of the Cowlitz Tribe at negotiations for the Chehalis River Treaty of 1855.

Ethnographic evidence demonstrates historical activity in the park, and current indicate ongoing contemporary uses of the park by Indian people. As the park broadens its research and collaborative efforts with tribal groups, it is likely that traditional Native American uses of Mount Rainier will become better understood. Partnerships provide an opportunity for native tribes and the park to cooperate in mutually beneficial efforts for the purpose of preserving the park's resources to their fullest extent and highest level of integrity (National Park Service 2001).

Surrounding Lands

The park is bordered primarily by U.S. Forest Service land, including the

- Mt. Baker- Snoqualmie National Forest to the southwest, northwest and northeast
- Wenatchee National Forest to the east and southeast, and
- Gifford Pinchot National Forest to the south.

In addition, four U.S. Forest Service wilderness areas (managed by the above forests) share a common boundary with the park:

- Clearwater Wilderness (14,598 acres);
- William O. Douglas Wilderness (166,603 acres);
- Tatoosh Wilderness (15,700 acres);
- Glacier View Wilderness (3,080 acres);

and the Goat Rocks Wilderness is located nearby.

These designated wilderness areas are also called "Congressionally Reserved Areas" under the *Northwest Forest Plan*" *(*USFS and BLM, 1994).

Most of the bordering non- wilderness forest lands are classified by the USFS as "late successional reserves", which are being managed over the long- term to protect and enhance late successional and old growth forest characteristics, including habitat for the northern spotted owl. Although thinning and silvicultural treatments are allowed in these reserves, they can only occur in stands up to 80 years of age and only if the treatment is determined to be beneficial to the creation and maintenance of late successional forest conditions.

Private lands are located along the park's western boundary in Pierce County. Rainier Timber Company, LLC (formerly International Paper and Champion Pacific Timberlands, Inc.) owns about 120,000 acres of land adjacent to the west park boundary and Plum Creek owns three sections of productive timberland adjacent to the northwest park boundary.

Lands adjacent lands to Mount Rainier National Park are comprised of private lands (13%), USFS lands (54%) and USFS Wilderness (33%). The perimeter of the park is 85 miles, with private lands totaling 10.9 miles, USFS Late Successional Reserve and Matrix lands 27.9 miles, and USFS Wilderness 46.2 miles.

Climate

The climate of Mount Rainier National Park exhibits climatic characteristics affected by both internal topography and its location on the west slope of the Cascades. Moderately cold winters with deep snow accumulations are often followed by mild, dry summers. Park weather is often dramatically different from that in the surrounding lowlands. Low lightning activity and significant amounts of rainfall have produced an ecosystem with a low fire incidence and a long fire cycle.

Annual precipitation is high, ranging from about 60 inches at low elevations to over 100 inches at subalpine levels. Most winter precipitation is in the form of snow, accumulating in snow packs of 20 or more feet in depth. Paradise total annual average snowfall is approximately 675 inches or 56.5 feet. In the record year (1972), 1,122 inches or 93.5 feet of snow occurred. As a result, snow often remains on the ground until June or July at Paradise and sometimes does not dissipate entirely over the summer in other parts of the park (e.g., Cayuse Pass). In another example, Paradise still had a significant amount of snow on the ground in early

August 1999. Winter storm winds are from the west and southwest forming a rainshadow on the eastern and northeastern sides of the park. Fog, wind, snow or rain may occur any day of the year.

In late summer and fall, strong dry north to east winds may produce extreme fire dangers. Two weather types produce this fire behavior. One is a cold- front passage followed by a bulge of the Pacific High extending inland over the coast. Northeasterly winds blowing down slope produce a warming and drying foehn wind. The second type follows when higher pressure develops east of the Cascades while a trough lies off the coast, resulting in dry easterly winds causing high fire danger on the west slopes of the Cascades. Airflow keeps the marine air offshore and results in adiabatic warming as the air flows from higher elevations down to sea level.

Precipitation

Orographic lifting on the western slopes of the Cascades from an influx of moist air from the Pacific Ocean results in some of the highest precipitation levels in North America, ranging from 60" at low elevations to over 100" at subalpine levels. Paradise (5,400 feet) averages 126 inches of precipitation, with the total average snowfall at 682.3 inches, average snow depth of 80 inches and highest recorded snowfall at 1,122 inches in 1972 (a former world record bested by Mount Baker in 1998- 1999). Longmire, at 2,761 feet averages 87 inches of rain per year and Ohanapecosh (1,900 feet) averages 75 inches. The driest areas in the park are on the east side of the mountain and are caused by the rain shadow effect wherein system lifting and cooling causes most of the precipitation to fall on the west side of the mountain as systems track from the west to the east. The summer- dominant Pacific high has a significant effect on regional fire weather and contributes to dry summer months with extended periods (often up to six weeks) of no precipitation. Mount Rainier National Park is in the North Pacific Coast fire climate region.

Temperature

The average maximum temperature for the warmest month, August, is 61.5 degrees Fahrenheit at Paradise. At Longmire, the average high temperature is in July at 75 degrees F and at Ohanapecosh in August at 81 degrees F. The average minimum temperature at Paradise is 20.3 degrees F in January. The average lows for Longmire and Ohanapecosh during the months of June through September is about 45 degrees F. Ambient temperatures are commensurate with environmental lapse rates, where temperature decreases proportionally with elevation.

Relative Humidity

Clouds often obscure the Mountain. The lower elevations are often cushioned by low level cloudiness. Occasionally, however, inversions will produce moist fog layers in low lying river valleys and forests below the park, while elevations from the subalpine on up will be bathed in sunshine. A similar occurrence occurs with some coastal fogs occurring during the summer and late fall which do not quite reach the west side of the park, often leaving the park in sunshine, while lower Puget Sound communities, often as far east as Eatonville are shrouded in fog.

HISTORIC ROLE OF FIRE

Fire Ecology

Fires tend to be infrequent in the forests and meadows of Mount Rainier. However infrequent, though, fires are by far the most important disturbance factor affecting forests on a wide scale in the park. Hemstrom and Franklin (1982) suggest a natural fire rotation of 465 years for the montane forests, with substantial variance in that figure from century to century. This long rotation period often allows forest succession to proceed to the climax forest condition. Below about 3,000 feet elevation, western hemlock (*Tsuga heterophylla*) is the dominant climax species. Above 3,000 feet elevation, it gives way to Pacific silver fir (*Abies amabilis*). In the mountain hemlock zone, extending to 6,500 feet, whitebark pine (*Pinus albicaulis*), subalpine fir (*Abies lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*) are the persistent species.

In the *Western Hemlock Zone*, disturbance by fire kills most of the trees inside the fire boundary.

Occasionally, scattered Douglas- fir (*Pseudotsuga menziesii*), survive to become markers of an earlier fire. Douglas- fir live up to 1,000 years, and as an early seral species only reproduce in open conditions. After a fire, this species usually dominates early successional stands, but later successional species such as western hemlock (and in the east) grand fir (*Abies grandis*) are also present. Over centuries, these later successional species will replace Douglas- fir as individual Douglas- fir die; however, total replacement can take 700-1,000 years.

Throughout much of the *Pacific Silver Fir Zone*, Douglas- fir shares early successional dominance with noble fir (*Abies procera*) and western white pine (*Pinus monticola*). The ages of these trees are often used as indicators of a past disturbance. As stands grow older, Pacific silver fir assumes a more important role in the forest over story and understory.

Successional dynamics at high elevations are difficult to determine. Extreme environments for tree regeneration often result in the conversion of forests to shrub and herbaceous environments for a century or more. The diversity of the landscape in the *Mountain Hemlock Zone* depends on the balance between forest and non- forest vegetation, and how fire affects that balance. Huff and Agee (1991) affirmed the importance of fire in maintaining mountain hemlock meadow ecosystems. Similar studies in the Olympic Mountains (Agee and Smith, 1984) suggest that post- fire forest recovery depends on good seed producing years in adjacent forest and mild, moist summers. Large burned areas remain meadows for over a century. Henderson (1973) shows a great diversity in pioneer communities and community routes, reflecting in part the wide diversity in meadow environments found at Mount Rainier.

In summary, fire has been a factor in plant community development at Mount Rainier for millennia. The character of both western hemlock and mountain hemlock forests reflects the influence of fire, although in some cases the stands have been undisturbed for many centuries. Continuation of the role of fire is essential if the natural diversity and structure of the park forests and meadows are to be maintained for future generations.

Fire History

Disturbance of park vegetation by fire is an important natural process that has played a prehistoric and historic role in forming the mosaic of vegetative communities at Mount Rainier National Park. Natural stand replacement, on (western Cascade slope) forests, almost inevitably results from fire. In a western hemlock/Douglas- fir forest the natural fire regime is one of infrequent crown and severe surface fires that usually result in total mortality of the trees in the stands (Agee 1981). These disturbances permit the establishment of even- aged classes of early seral stage conifers (Hemstrom and Franklin, 1982). All but a small fraction of the forest area has been affected during the last 1,000 years (Hemstrom and Franklin, 1979). Frequency of prehistoric fires must be determined from vegetation map patterns, aerial photos and fire scar analysis. From research, the average natural fire rotation for Mount Rainier has been determined to be approximately 465 years (Franklin *et al.* 1988).

Huff and Agee (1991) state

> "We found fire to be a major disturbance factor in subalpine forests, similar to other forests..." "It is clear that subalpine fir forests in this region are linked to recurring fire. Subalpine meadows, however, exhibit characteristics more related to snow depth than time since last fire disturbance. Many low elevation subalpine meadows and treed meadows would not exist in these areas without fire. The diversity and patchwork of meadows, tree clusters, and forests would be altered without fire. If global warming becomes a reality, fire will likely be a major initiator of new forest development patterns."

Fire frequency varies with topographic position. The ages of major fire episodes vary along different slope aspects. For example, in the Ohanapecosh River valley, north and east facing slopes contain old growth forests of 700+ years. South and west facing slopes have stands 350 years old or less. The White, Cowlitz and Nisqually River drainages have burned most frequently because of a general southerly aspect and lack of

natural barriers to prevent disturbances outside the park from burning into the park (Hemstrom and Franklin, 1982 and Franklin *et al.* 1979).

Historically, the sources of ignition have been lightning, aboriginal humans and modern humans. To what degree fires in the park had human origins is not yet clear, however one of the most specific references is from Forests of Mount Rainier National Park (G.F. Allen 1922) which contains the following description.

> "The old burns in the middle altitudes of the park occupy regions once frequented by the Klickitat Indians. Every summer parties of hunters and berry pickers from the sagebrush plains crossed the Cascades with their horses. They followed the high divides and open summits of the secondary ridges until they came around to the open parks about Mount Rainier where they turned their horses out to graze and made their summer camp. The women picked huckleberries and the men hunted deer and goats. They made great fires to dry their berries and kindled smudges to protect their horses from flies. It was also their custom to systematically set out fires as they returned. Burning made the country better for the Indians. The fires kept down the brush and made it more accessible. Deer could be more easily seen and tracked and the huckleberry patches spread more widely over the hills.
>
> No considerable part of the lower forests of the park has been burned. The principal danger is from lightning. However, few of the trees struck are ignited and these fires are usually extinguished by the rain. . ."

A more recent reference drawn from work that analyzed the Native American fire influence on the surrounding Mount Rainier Forest Reserve (some of which later became part of the park) states that of 32 fires that occurred in 1904- 05, 16 were recorded to have been caused by American Indians (Mack 2003). Later the same article states:

> What we see here is a pattern of repeated fires set in areas where the tree cover is very light, either within or adjacent to existing larger burns. They were set at a time of year when either rain or snow could be counted on to extinguish them within a month's time. They could certainly be described as maintenance fires.

By only a few years later (1907) Mack (2003) states that only one of 22 fires was of Native American origin.

Native Americans may have set maintenance fires through the early part of the 20th century in old burns in the park and/or the Mount Rainier Forest Reserve (later national forest land) that continued to result in higher production of berry and/or ungulate forage (Allen 1904, Mack 2003) although the connection between increased berry production and increased fire frequency as studied by Minored *et al.* (1979) was inconclusive (Mack 2003). Anglo- Europeans were probably a significant influence in the mid- 1800s, setting clearing fires that may have moved into the park. During the twentieth century, Anglo- Europeans have both set and suppressed fires in the park. Lightning has historically been the most important ignition factor, and will probably continue to be so.

Historical records from 1850 to 1915 are sketchy. Documentation of this period indicates less than 100 fires that were over 20 acres in size. The largest fires, however, were up to 2,500 acres. Miners, hunters and sheepherders were active in the area and fires were either documented by or attributed to their activities. In 1880, the greatest acreage (2,540 acres) burned from two ignitions (Report from Chief Ranger's Office, 1953).

The largest single fire in the park's history was 11,000+ acres (1930) at Sunset Park, on the park's west side. The cause was right- of- way burning for construction of the Westside Road (Superintendent's Annual Report, 1931). The most frequent natural fires have been small, less than 1 acre in size; and are ignited on upper slopes. Major fires are typically intense, extensive and stand replacing, but of low incidence.

Fire information for the recent ten- year period (1987- 1997) shows a Normal Fire Year averaging eight starts. In 1990 there were at least 38 starts, 11 in 1991, and 11 in 1994. During this period, 83 total fires were reported. Of the 83 fires, 37 were lightning fires that naturally extinguished. From 1930- 1985 records, the frequency of human- caused fire accounts for 65 percent of all ignitions. These fires are concentrated near developed areas, allowing early detection and quick suppression. (**Fire Ignitions/Recent Fire History Map**)

In the past 10 years, the greatest number of recorded ignitions from lightning strikes for a single storm was 22 (1990); burning 8.4 acres. Records from 1928 to 1953 show 59 percent of recorded lightning fire starts

occurred between 4,500 feet and 5,500 feet in elevation (Report from Chief Ranger's Office, 1953).

Historic records show a normal year having few natural fires and many years where none occur at all. Few historic fires consumed over 1,000 acres. This fact is important in fire management implications. Fires are ecologically important even though recorded fire size under suppression response has been small. Therefore, it may be that each natural fire start is highly significant environmental process acting on an ecosystem. As a result, if continued suppression of naturally ignited wildland fires occurred, there could be significant changes over time to the successional conditions naturally occurring in the park. The past 100 years of fire suppression has likely already changed what would have been natural vegetation community characteristics in a landscape unaltered by direct fire suppression. As mentioned earlier, to the extent that Native Americans used fire in the park and surrounding areas, these conditions have also likely been altered by fire suppression.

Table 1: Ancient Fire History

(Adapted from Franklin *et al.* 1988 (Table 17): Major fires, their correspondence to period of drought, and the present and reconstructed original extent of resulting seral forests at Mount Rainier National Park (after Hemstrom and Franklin 1982).

Episode date (A.D)	Present forested area		Reconstructed Forested area		Drought period
	Acres	Percent of Total	Acres	Percent of Total	
1230	15475	12	61750	47	
1303	35802	3	14820	11	1290-95[2]
1403	17068	13	33839	26	1406-13[2]
1503	11609	9	33790	26	1477-90[2]
1628	5198	21	31863	24	1627-33[2]
1688	2964	2	10893	8	1986[3]
1703	6669	5	12696	10	1700[3]
1803	5508	4	5508	4	1801[3]
1825	5928	5	6126	5	1826-26[3]
1856	1210	1	6916	5	1856[3]
1858	7509	6	9139	7	1856[3]
1872	1482	1	1482	1	1869-73[2]
1886	9386	7	10572	8	1888[3]
1934	1902	1	1902	1	1917-36[2]

[1]No climatic reconstructions available for dates before 1250 A.D.
[2]Keen (1937) first- or second- magnitude drought.
[3]Blasing and Fritts (1976) abnormally dry winter.

Table 2: Recent Fire History

	Present Forested Area		Reconstructed Forest Area		
Episode Date A.D.	Acres	Percent of Total	Acres	Percent of Total	Drought Period
1931 (3)	Unknown	< 1	Unknown	< 1	Unknown
1932 (4)	Unknown	< 1	Unknown	< 1	Unknown
1933 (8)	Unknown	< 1	Unknown	< 1	Unknown
1934 (6)	Unknown	< 1	Unknown	< 1	Unknown
1935 (2)	Unknown	< 1	Unknown	< 1	Unknown
1936 (4)	Unknown	< 1	Unknown	< 1	Unknown
1937 (9)	Unknown	< 1	Unknown	< 1	Unknown
1938 (5)	Unknown	< 1	Unknown	< 1	Unknown
1939 (4)	Unknown	< 1	Unknown	< 1	Unknown
1940 (7)	Unknown	< 1	Unknown	< 1	Unknown
1941 (22)	Unknown	< 1	Unknown	< 1	Unknown
1942 (4)	Unknown	< 1	Unknown	< 1	Unknown
1943 (2)	Unknown	< 1	Unknown	< 1	Unknown
1945 (3)	Unknown	< 1	Unknown	< 1	Unknown
1946 (7)	Unknown	< 1	Unknown	< 1	Unknown
1947 (1	Unknown	< 1	Unknown	< 1	Unknown
1948 (2)	Unknown	< 1	Unknown	< 1	Unknown
1949 (11)	Unknown	< 1	Unknown	< 1	Unknown
1950 (4)	Unknown	< 1	Unknown	< 1	Unknown
1951 (7)	Unknown	< 1	Unknown	< 1	Unknown
1952 (1)	Unknown	< 1	Unknown	< 1	Unknown
1953 (1)	Unknown	< 1	Unknown	< 1	Unknown
1956 (4)	Unknown	< 1	Unknown	< 1	Unknown
1958 (4)	Unknown	< 1	Unknown	< 1	Unknown
1959 (1)	Unknown	< 1	Unknown	< 1	Unknown
1960 (2)	Unknown	< 1	Unknown	< 1	Unknown
1963 (10)	Unknown	< 1	Unknown	< 1	Unknown
1965 (7)	Unknown	< 1	Unknown	< 1	Unknown
1966 (1)	Unknown	< 1	Unknown	< 1	Unknown
1967 (2)	Unknown	< 1	Unknown	< 1	Unknown
1970 (1)	Unknown	< 1	Unknown	< 1	Unknown
1977 (17)	Unknown	< 1	Unknown	< 1	Unknown
1979 (4)	Unknown	< 1	Unknown	< 1	Unknown
1981 (1)	Unknown	< 1	Unknown	< 1	Unknown
1982 (12)	Unknown	< 1	Unknown	< 1	Unknown
1983 (1)	Unknown	< 1	Unknown	< 1	Unknown
1984 (1)	Unknown	< 1	Unknown	< 1	Unknown
1985 (4)	Unknown	< 1	Unknown	< 1	Unknown
1986 (3)	Unknown	< 1	Unknown	< 1	Unknown
1987 (4)	Unknown	< 1	Unknown	< 1	Unknown
1988 (2)	Unknown	< 1	Unknown	< 1	Unknown
1989 (5)	Unknown	< 1	Unknown	< 1	Unknown
1990 (38)	Unknown	< 1	Unknown	< 1	Unknown
1991 (11)	Unknown	< 1	Unknown	< 1	Unknown
1992 (8)	Unknown	< 1	Unknown	< 1	Unknown
1993 (1)	Unknown	< 1	Unknown	< 1	Unknown
1994 (13)	1.3	< 1	Unknown	< 1	Unknown
1994	unknown	< 1	Unknown	< 1	Unknown
1995	unknown	< 1	Unknown	< 1	Unknown

	Present Forested Area		Reconstructed Forest Area		
Episode Date A.D.	Acres	Percent of Total	Acres	Percent of Total	Drought Period
1997 (4)	0.8	< 1	Unknown	< 1	Unknown
1998 (7)	Unknown	< 1	Unknown	< 1	Unknown
1999 (4)	Unknown	< 1	Unknown	< 1	Unknown
2000 (3)	0.3	< 1	Unknown	< 1	Unknown
2001 (5)	0.5	< 1	Unknown	< 1	Unknown
2002 (8)	13.0	< 1	Unknown	< 1	Unknown
2003 (11)	391.6	< 1	Unknown	< 1	Unknown
2004 (?)	Unknown	< 1	Unknown	< 1	Unknown

Fire Season

The normal fire season, derived from FIREPRO analysis, is June 21 through September 10, although lightning storms may extend from late May to late September. Major fires have occurred during prolonged drought (Franklin *et al*.1979). The number of consecutive days without rainfall during the fire season, and the number of years with less than average precipitation, are important in determining fire frequency. Weather records from Longmire show a cycle of 4.2 peak- wet years and 4.1 dry years. This cycle correlates to fire activity within the park (report from Chief Ranger's Office, 1953).

Lightning storms are generally infrequent in the vicinity of Mount Rainier. In the past 67 years (1930- 1997), only 234 lightning ignitions have been recorded (Mount Rainier Fire Atlas 1930- 1979, and 1980, FIREPRO 1979- 1997). There were 22 lightning ignitions in 1990. Summer lightning storms most commonly come from the south or southeast. Typically, light to heavy rain occurs during and after storms, restricting the spread of ignitions. However, smoldering fires can spread if the lightning storm is followed by dry, warm days, especially in conjunction with east winds.

Conditions to be concerned about within the park include:

- periods of mild snow accumulation during very mild or dry winters;
- snowfall or rainfall (including both long and short term) drought conditions combined with a warmer than usual summer;
- lightning strike weather conditions;
- east wind patterns;
- large outbreaks of forest disease or insect infestations;
- large areas of wind- thrown timber; or
- large areas of ice damaged trees.

Fire Behavior

The behavior of naturally occurring wildfires in Mount Rainier National Park is not well documented primarily because the interval between fires is great. In addition, documentation of fire behavior is a relatively recent strategy. Fire behavior is not uniform and may vary substantially from site to site as a function of weather, fuels, and topography. With a cool, moist environment, the park ecosystems are not conducive to frequent fire. As a result, there are few fires in modern times from which careful observations have been recorded. Fire behavior can be predicted from a variety of sources, including BEHAVE fire prediction software.

The best source of fire behavior information is Hemstrom and Franklin's (1982) "*Fire and other disturbances of the forests in Mount Rainier National Park*." Several fire behavior implications can be drawn from this largely ecologically based study. The first is that although fires tend to be infrequent they are usually of high

severity (i.e., they kill most of the trees within the fire perimeter). This suggests that they are of moderate to high fire line intensity (rate of heat release). Many of the fires of the distant past are part of what Hemstrom and Franklin call "fire episodes," or one or more individual fire events occurring so close in time that they cannot be separated using the typical reconstruction method of forest age class analysis. These fire episodes suggest two important characteristics of fires in the park: (1) the episodes can cover large areas with multiple fires, and (2) these large fires either burned from inside the park to areas outside, or vice versa.

The techniques employed by Hemstrom and Franklin resulted in the "fire episode" being the primary focus of their study. Fires smaller than 250 ha (just over 615 acres) were largely ignored. However, smaller fires have occurred in the past, will continue to occur, and will continue to have a significant cumulative effect on ecosystems of the park.

General factors affecting fire behavior include fuel moisture, wind, heat transfer methods (radiation, conduction and convection), and fuel type and arrangement. Conditions, which allow a lightning- set fire to grow to substantial size, have not been studied in the park to any extent. However, a study at Olympic National Park suggests that four factors are associated with fires exceeding 1 ha (2.47 acres) in size:

1) long- term drought (exceeding several months),
2) short- term drought (weeks),
3) ignition (lightning), and
4) occurrence of an east wind pattern (associated with low humidity and high wind velocity) before significant precipitation falls.

The same regional patterns probably affect fires at Mount Rainier. Therefore, critical fire weather would tend to encourage fire in the northeast quadrant of the park to spread primarily into the park. On the southeast quadrant, valley winds might offset gradient winds at times, so that both up and down slope and up and down valley spread is likely. On the western half of the park, valley winds will typically be moving perpendicular to gradient winds, so that up and down slope spread will dominate up and down valley fire spread (assuming that gradient winds are greater than valley winds or topographic effects).

Seasonal occurrence of fires will probably focus on June- September for montane zones and July- September for subalpine zones. Because of fuel discontinuities, subalpine fires will generally be smaller than those in the montane zones will. Fires may be expected under unusual conditions outside of these periods. For example, in 1987, three subalpine fires occurred while snow was still on the ground in early May. This was attributed to the effects of very warm weather causing crown moisture stress in trees whose roots were in frozen soil and would not allow moisture transmission to replenish water lost from the crowns. In addition, there was a significant component of lichens in the crown that quickly responded to the low relative humidity and high ambient temperatures, becoming a very dry fine fuel bed. A lightning storm passed through and ignited the tree crowns. This type of fire, depending on location, could potentially spread into facilities and would be difficult for fire suppression crews to control.

Fires moving uphill tend to move faster due to the flames moving up and preheating the fuel ahead through convection. With less effective combustion due to heavy branches, and water vapor of fuel loads, decreased consumption of organic matter may occur. This results in a greater patchiness of fire effects in steep terrain.

Range of Potential Fire Behavior

A wide range of potential fire behavior has occurred within the park. Fires include slow or fast moving meadow fires, creeping duff fires, and rapidly moving, crowning fires with greater intensity, higher flame lengths and increased consumption of ground fuels. These types of fire behavior may all occur in the same fire event.

Historic weather data from the Ohanapecosh and Longmire weather stations was used to evaluate potential fire behavior. At Ohanapecosh, winds are generally out of the south and southwest with maximum-recorded wind speeds of 18 miles per hour. At Longmire, winds are out of the southeast and south with

maximum- recorded wind speeds also of 18 miles per hour. The wind direction for the Longmire station likely reflects the prominent down canyon winds that occur in the afternoon at the time weather is taken. Fire behavior was calculated with BEHAVE, using weather conditions from the Ohanapecosh station. Fires typically smolder or burn slowly in moist fuels with many fires burning out before they reach 0.1 acre in size. Under moderate to high fire weather conditions, fires can burn rapidly (600 feet/hour) up south and southwest facing slopes where there is heavy fuel on the ground or in dry meadows. In much of the forest, where the surface fuels are relatively sparse, fire will burn slowly uphill, burning up to 200 feet in an hour. Under extreme conditions, crown fires with spotting up to 0.5 mile ahead of the fire and spread faster than 0.25 miles in an hour, are possible in areas with heavy fuels. Such extreme conditions, however, rarely occur in the park. On north and northeast slopes, fire will be relatively inactive due to shading, cool temperatures, and higher fuel moistures.

- Historical annual fire activity was infrequent and small in size, although recent human- caused fires in excess of 11,000 acres have occurred and the ancient fire history shows fires of more than 60,000 acres.
- Although infrequent, high intensity fires usually exhibit high severity, killing most of the trees within the fire boundary. Such fires are potentially extremely dangerous to monitoring or suppression personnel.
- Situations indicative of potentially severe fire activity (recent drought years, drought during current season, wildland fire ignitions with east winds and little precipitation) have been correlated with large fire incidence and will be monitored.
- Effects of the global climate change theory on the natural fire cycle are unknown, but warrant consideration. Increased temperatures and reduced precipitation could accelerate the fire cycle and lead to more frequent and intense fire activity.

Air Quality

Mount Rainier National Park is in a mandatory Class I area under the Clean Air Act (1977). Class I areas are afforded the highest degree of protection under the Clean Air Act. This designation allows very little additional deterioration of air quality. The Clean Air Act states that park managers have an affirmative responsibility to protect park air quality related values (including visibility, plants, animals, soils, water quality, cultural resources and visitor health) from adverse air pollution impacts. Special visibility protection provisions of the Clean Air Act also apply to Class I areas, including new national rules to prevent and remedy regional haze affecting these areas. Under existing visibility protection regulations, the NPS identified "integral vistas" that are important to the visitor's visual experience in NPS Class I areas, and it is NPS policy to protect these scenic views.

Any impacts to air quality, therefore, are considered potentially detrimental. In contrast to surrounding metropolitan areas, air quality within the park is usually good; however, high ambient sulfate levels, low pH levels of airborne water droplets, and high ozone levels have all been documented. Visibility impacts confined to wilderness and due to naturally ignited wildland fires are generally more acceptable than impacts occurring outside of wilderness, especially when coupled with an interpretive program explaining the benefits of fire. Campfires, generators, heating systems and the operation of motor vehicles and equipment all may cause local, temporary air quality degradation. Because the park is surrounded by developed areas in King, Pierce, Lewis and Yakima counties, stationary and mobile emissions in the region are the major source of air pollution near the park. These include industrial developments, power plants (notably the Centralia Power Plant), and logging, slash burning, pulp and paper mills, etc. The Clean Air Act also requires consideration of the protection of air quality related values, such as visibility and scenic vistas that are occasionally significantly affected by non- attainment particulate concentrations in the surrounding areas.

National Ambient Air Quality Standards (NAAQS)

National Ambient Air Quality Standards (NAAQS) must be met. The federal Clean Air Act (as amended in 1990) required the Environmental Protection Agency (EPA) to identify NAAQS to protect public health and welfare. Standards have been set for six pollutants: ozone (O_3), carbon monoxide (CO), Nitrogen dioxide

(NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns (PM_{10}), and lead (Pb). In 1997, EPA promulgated revised NAAQS for ozone and a new NAAQS for particulate matter less than 2.5 microns ($PM_{2.5}$). In the spring of 1999, a U.S. Court of Appeals panel remanded the standard to EPA for further consideration. However, in early 2001, the Supreme Court upheld EPA's authority to set these new, more stringent, standards.

The pollutants are called criteria pollutants because the standards satisfy criteria specified in the Clean Air Act. An area where a standard is exceeded more than three times in three years can be considered a nonattainment area and is subject to more stringent planning and pollution control requirements. Federal ambient air quality standards have been set for carbon monoxide, nitrogen dioxide, ozone, lead, particulates smaller than ten microns, particulates smaller than 2.5 microns and sulfur dioxide. The park is located in Pierce and Lewis counties, where it is regulated by the Puget Sound Air Pollution Control Authority (PSAPCA), within the Washington Department of Ecology.

NPS Air Quality Policy Guidance

A principal park management objective is to manage air quality effects of prescribed burning by working with county and state air resources personnel and using the latest technology to monitor and manage smoke- related effects upon visitors, residents, and employees. In addition to complying with state and local air quality rules and regulations, the NPS also has developed guidance on air quality and smoke management related to wildland and prescribed fires. This guidance is contained in Chapter 14 of the National Park Service Reference Manual18: Wildland Fire Management, which is dated February 1999. Guidance and policies from the EPA also supplement the NPS guidance. These include the Interim Air Quality Policy on Wildland and Prescribed Fires, Federal Wildland Fire Management Policy, and PM_{10} Natural Events Policy. In 1998, the EPA developed an interim policy for addressing public health and welfare impacts caused by wildland and prescribed fires that are managed to achieve resource benefits. Ambient air quality worse than the national ambient air quality standards (NAAQS) for $PM_{2.5}$ and PM_{10} is used as the principal indicator of public health impacts. Visibility impairment is used as the principal indicator of public welfare impacts. This policy complements the Natural Events Policy to address public health impacts caused by wildfires.

Integral Vistas

In 1980, the following two vistas were inventoried and selected as integral vistas: Tolmie Lookout and Camp Muir. Integral vistas warrant special protection under NPS implementation of the Clean Air Act. Other important vistas (but not selected as integral) are Klapatche Point, Ricksecker Point, Paradise Visitor Center, Pinnacle Peak, Upper Stevens Canyon, Mid- Stevens Canyon, Box Canyon Picnic Area, Box Canyon Overlook, Backbone Ridge, East side, Backbone Ridge, Chinook Pass, Tipsoo Lake, Sunrise Point, and Mount Fremont Lookout.

Soils

The park contains areas of high elevation solid rock and talus slopes with virtually no soil to low elevation glacial valleys with well- developed organic soils. Hobson (1976) classified park soils into four types as follows: tephra soils (pyroclastic deposits identified by individual ash layers); colluvial soils (coarse, unconsolidated soils of mixed parent materials); alluvial soils (river or glacially deposited soils); and mudflow soils (surface or subsurface parent materials resulting from volcanic mudflows). Beyond, the work done by Hobson, however, there is little information on park soils, although Franklin *et al.* (1988) described additional soil information.

Tephra soils are common in forest communities and are comprised of volcanic parent materials (ash, pumice, etc.). They are typically coarse sands or gravelly sandy loams with less than 10 percent organic material.

Colluvial soils are the dominant soil group in the park (Franklin *et al.* 1988). They are generally unstable rapidly drained and consist of coarse, unconsolidated mixed parent materials. They are found on slopes at all elevations, but especially the steeper slopes and south facing aspects. Based on inference, many of the

steep slopes adjacent to park roadways that do not consist of rock or talus may have significant areas of these unconsolidated, erodible soils.

Alluvial soils occur in major river valleys, along streams, wet benches and alluvial slopes and fans. They consist of coarse undifferentiated fine or very fine sands. Alluvial deposits are of varying thickness and texture.

Mudflow soils result from lahars (volcanic debris flows). They are characterized by poorly sorted materials and often include rounded rocks and boulders intermixed with fine loamy sands, cobbles and gravel.

Water Resources

Water Quality/Water Quantity

Mount Rainier is the "place where the rivers begin" in the Puget Sound and beyond. Park water resources are diverse and include alpine lakes, waterfalls, glacially fed rivers and mineral springs. Nine major rivers as well as numerous significant creeks (Kautz, Tahoma, etc.) flank the mountain. In all, there are approximately 383 perennial streams and 84 intermittent streams in the park. In addition, there are some 405 lakes, mineral geothermal springs, etc. With very few exceptions, park rivers and streams originate within the park. (Exceptions include some portions of the Huckleberry Creek Watershed, Chenuis Creek Watershed and Nisqually River watershed.) National Wetlands Inventory maps indicate at least 2,321 wetlands covering 3,200 acres.

Physical, chemical and biological data is available for many lakes, streams and wetlands. Data include water and air temperature, aquatic biota (fish, amphibians, invertebrates), conductivity, dissolved oxygen, pH, turbidity, alkalinity, suspended solids, dissolved solids, total nitrogen (including nitrate, nitrite, and ammonia), total phosphorus and orthophosphate, silica, sodium, potassium, calcium, chloride, sulfate, and magnesium. In addition, there is information on size, perimeter, elevation, wetland delineation, and stream order.

Flow and discharge information is significantly lacking. No functional gauging stations are located within the park.

Some park waters may be impacted by park operations, including wastewater treatment plants (Paradise River, Nisqually River, Ohanapecosh River – although the latter two discharge to groundwater); septic systems (White River, Carbon River, Sunrise, etc.); stormwater and snowmelt runoff from roads (Tipsoo Lake, Reflection Lakes, etc.); and developed areas (Nisqually River, Paradise River, Ohanapecosh River, White River, Carbon River) in addition to natural erosion from hillsides.

TABLE 3: MAJOR RIVERS/WATERSHEDS

Major Rivers	Drains To	Destination	Watershed Acreage
Carbon River	Puyallup River	Puget Sound	25,884
Cowlitz River	Columbia River	Columbia River	27,644
Huckleberry Creek	White River	Puget Sound	13,741
Mowich River	Puyallup River	Puget Sound	19,350
Nisqually River		Puget Sound	37,791
Ohanapecosh River	Cowlitz River	Columbia River	41,398
Puyallup River (North and South Fork)		Puget Sound	13,320
West Fork White River	White River	Puget Sound	17,281
White River		Puget Sound	38,997

Park water quality within most park rivers would meet Class AA water standards according to data collected at the Nisqually River station near Longmire (Samora 1998). Class AA waters are characterized by exceptional water quality and are designated under the state administration of the Clean Water Act. Park

waters are currently being considered for listing as Outstanding Natural Resource Waters under the Antidegradation Policy of the Clean Water Act.

Vegetation

Three broad vegetation types are represented within Mount Rainier National Park. These are 1) coniferous forest (1,500- 5,000 feet elevation); 2) subalpine parkland (5,000- 7,000 feet) and 3) alpine (generally above 7,000 feet, where the ground is not covered by ice and snow). Ice, permanent snowfields, rock and bare ground make up park areas not covered by vegetation.

Park forests are dominated by western hemlock, Douglas- fir, western red cedar (Thuja plicata), Pacific silver fir, mountain hemlock (*Tsuga mertensiana*), Noble fir (*Abies procera*), grand fir (*Abies grandis*), subalpine fir (*Abies lasiocarpa*) Alaska yellow cedar (*Chamaecyparis nootkatensis*), Engelmann spruce (*Picea engelmannii*), western white pine (*Pinus albicaulis*), and lodgepole pine (*Pinus contorta*). Deciduous trees include: bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and black cottonwood (*Populus balsamifera*). Variation in park forests relates primarily to three factors: temperature regime, moisture (including snow) regime, and the length of time the forest has gone undisturbed (Franklin *et al.* 1988). Wildfire has been the most important forest- destroying agent near Mount Rainier and has affected all but a small fraction of the forest area during the last 1,000 years (Franklin *et al.* 1988).

Franklin *et al.* (1988) identified the following major forest zones:
TSHE: *Tsuga heterophylla* or Western Hemlock Zone
ABAM: *Abies amabilis* or Pacific Silver Fir Zone
TSME: *Tsuga mertensiana* or Mountain Hemlock Zone.
More specific information on these zones related to fuel types is found in the accompanying FMP. These were further divided into 14 plant associations and 5 community types in the park (Franklin *et al.* 1988) as follows:

TABLE 4: FOREST PLANT ASSOCIATIONS/COMMUNITY TYPES

FOREST PLANT ASSOCIATIONS Scientific Names	**Common Names**	**Forest Type**
Tsuga heterophylla/ Achlys triphylla	Western hemlock Vanilla leaf	TSHE
Tsuga heterophylla/ Polystichum munitum	Western hemlock Sword fern	TSHE ABAM (depending on phase)
Tsuga heterophylla/ Oplopanax horridum	Western hemlock Devil's club	TSHE
Abies amabilis/ Oplopanax horridum	Pacific silver fir Devil's club	ABAM (both phases)
Abies amabilis/ Tiarella unifoliata	Pacific silver fir Foam flower	ABAM
Abies amabilis/ Vaccinium alaskaense	Pacific silver fir Alaska huckleberry	ABAM (all phases)
Tsuga heterophylla/ Gaultheria shallon	Western hemlock Salal	TSHE
Abies amabilis/ Berberis nervosa	Pacific silver fir Kinnikinnick	ABAM
Abies amabilis/ Xerophyllum tenax	Pacific silver fir Bear grass	ABAM TSME (depending on phase)
Abies amabilis/ Rubus lasiococcus	Pacific silver fir Dwarf bramble	ABAM and/or TSME (all phases)
Abies amabilis/ Rhododendron albiflorum	Pacific silver fir White-flowered	TSME

	rhododendron	
Chamaecyparis nootkatensis/ Vaccinium ovalifolium	Alaska cedar Oval leaf huckleberry	TSME
Abies amabilis/ Menziesia ferruginea	Pacific silver fir False azalea	ABAM and TSME (both phases)
FOREST PLANT COMMUNITY TYPES	**Common Names**	**Forest Type**
Alnus rubra/ Rubus spectabilis	Red alder Salmonberry	TSHE and ABAM
Pseudotsuga menziesii/ Ceanothus velutinus	Douglas-fir Snowbrush	TSHE and ABAM
Pseudotsuga menziesii/ Xerophyllum tenax	Douglas-fir Bear grass	ABAM
Pseudotsuga menziesii/ Viola sempervirens	Douglas-fir Evergreen violet	ABAM
Abies lasiocarpa/ Valeriana sitchensis	Sublapine fir Sitka valerian	TSME

Common forest plants include:
Salal (*Gaultheria shallon*), huckleberry (*Vaccinium* sp.) – 7 species, white- flowered rhododendron (*Rhododendron albiflorum*), kinnikinnick (*Arctostaphylos uva- ursi*), twinflower (*Linnaea borealis*), Indian-plum (*Oemleria cerasiformis*), salmonberry (*Rubus spectabilis*), thimbleberry (*Rubus parviflorus*), five- leaved bramble (*Rubus pedatus*), dwarf bramble (*Rubus lasiococcus*), devil's club (*Oplopanax horridus*), red-flowering currant (*Ribes sanguineum*), sitka willow (*Salix sitchensis*), cascara (*Rhamnus purshiana*), Sitka alder (*Alnus crispa*), beaked hazelnut (*Corylus cornuta*), vine maple (*Acer circinatum*), oregon grape (*Mahonia nervosa*), false solomon's seal (*Smilacina racemosa*), false lily of the valley (*Malanthemum dilatatum*), queen's cup (*Clintonia uniflora*), bear grass (*Xerophyllum tenax*), western coralroot (*Corallorhiza maculata*), foamflower (*Tiarella trifoliata*), yellow wood violet (*Viola glabella*), white- veined wintergreen (*Pyrola picta*), pipsissewa (*Chimaphila umbellata*), vanilla leaf (*Achlys triphylla*), inside- out flower (*Vancouveria hexandra*), redwood sorrel (*Oxalis oregana*), wild ginger (*Asarum caudatum*), bunchberry dogwood (*Cornus canadensis*), skunk cabbage (*Lysichiton americanum*), sword fern (*Polystichum munitum*), deer fern (*Blechnum spicant*), and lady fern (*Athyrium filix- femina*).

Park subalpine and alpine meadows are well known for their beauty and diversity. These meadows can be divided into the following types:

- Heather- Huckleberry (*Phyllodoce- Cassiope- Vaccinium*)
- Black sedge (*Carex nigracans*)
- Green fescue (*Festuca viridula*)
- Lush herbaceous – Sitka valerian/False hellebore (*Valeriana- Veratrum*)
- "Rawmark" or early successional – Tolmie's saxifrage (*Saxifraga tolmei*)

The distribution patterns of these plant communities is largely determined by the depth and duration of snow pack (Franklin *et al.* 1988). Another classification of upper elevation areas in the park identified fellfields, heath shrub meadow, alpine meadow, heath lush herbaceous meadow, tall shrub meadow, low herbaceous meadow, lush herbaceous meadow, dry grass meadow, krummholtz, subalpine woods, lush streamside and wet sedge meadow (Restoration Handbook 1990).

Common subalpine plants include:
White mountain heather (*Cassiope mertensiana*), pink mountain heather (*Phyllodoce empetriformis*), red mountain heather (*Phyllodoce glanduliflora*), kinnikinnick, sitka mountain ash (*Sorbus sitchensis*), false azalea (*Menziesii ferruginea*), false hellebore (*Veratrum viride*), avalanche lily (*Erythronium montanum*), Tolmie's saxifrage, Newberry's fleeceflower (*Polygonum newberryi*), bistort (*Polygonum bistortoides*), spreading phlox (*Phlox diffusa*), western anemone (*Anemone occidentalis*), louseworts (*Pedicularis* sp.), cinquefoil (Potentilla flabellifolia), rosy spirea (*Spirea rosea*), marsh marigold (*Caltha biflora*), gentian (*Gentiana* sp.), orange agoseris (*Agoseris glauca*), subalpine daisy (*Erigeron peregrinus*), alpine aster (*Aster alpigenus*), alpine

pussytoes (*Antennaria alpina*), sitka valerian (*Valerian sitchensis*), green fescue (*Festuca viridula*), black sedge (*Carex nigracans*), showy sedge (*Carex spectabilis*), wood rushes (*Luzula* sp.), spike trisetum (*Trisetum spicatum*), oat grass (*Danthonia intermedia*), mountain hairgrass (*Deschampsia atropurpurea*).

Wildlife

Sixty species of mammals are known to inhabit Mount Rainier National Park. Another three occurred historically but have not been documented recently. Small mammals include the deer mouse, dusky shrew, Townsend's chipmunk, Douglas squirrel, flying squirrel, hoary marmot, pika and snowshoe hare. Small and medium- sized carnivores include the long- tailed weasel, pine marten, raccoon, striped and spotted skunks, river otter, bobcat, red fox and coyote. Large mammals include the black bear, black- tailed deer, elk, mountain goat and mountain lion. In addition, a number of bats occur in the park, including a nursing colony of the long- eared myotis and the state and federally sensitive Townsend's big- eared bat.

There are over 229 species of birds listed for the park, with approximately 80 of these known to nest in the park (see Checklist of the Birds of Mount Rainier National Park 1995). Raptors include the northern goshawk, Cooper's hawk, red- tailed hawk, sharp- shinned hawk, peregrine falcon, merlin, bald eagle, golden eagle, northern saw- whet owl, barred owl, great horned owl, western screech owl, etc. Other bird species include the gray jay, varied thrush, red- breasted sapsucker, common flicker, pileated woodpecker, Steller's jay, Oregon junco, hermit thrush, gray- crowned rosy finch, white- tailed ptarmigan, etc.

Approximately 21 species of reptiles and amphibians occur in the park. Amphibians include the western redback salamander, Pacific giant salamander, northwestern and long- toed salamanders, tailed frog, Pacific chorus frog, red- legged frog, Cascades frog and western toad. Reptiles include the northwestern garter snake, western terrestrial garter snake, northern alligator lizard, rubber boa, etc.

Eighteen native species of fish occur in the park, including rainbow trout/steelhead, coho and chinook salmon, sculpin, bull trout and coastal cutthroat trout. In addition there are a number of introduced fish (including brook trout (*Salvelinus fontinalis*).

In addition, there are a wide variety of known and unknown invertebrates, including insects, spiders, worms, and freshwater mussels.

Elevational Life Zones: Mount Rainier National Park is home to a wide variety of animal species. There are four distinct life zones in which animals occur, although some animals may inhabit several of the life zones depending on the time of year.

Below 3,500 Feet

The lowest areas of the park (below 3500 ft) are characterized by having mature forests of Douglas- fir, western red cedar, grand fir and western hemlock. This zone provides suitable habitat for the northern spotted owl (*Strix occidentalis caurina*), and marbled murrelet (*Brachyramphus marmoratus*) (see specific information below under *Threatened and Endangered Species*). Other birds found in this life zone are barred owls (*Strix varia*), Cooper's hawk (*Accipiter cooperii*), varied thrush (*Ixoreus naevius*), brown creeper (*Certhia americana*), red- breasted sapsucker (*Sphyrapicus varius*), common flicker (*Colaptes auratus*), Steller's jay (*Cyanocitta stelleri*), red- breasted nuthatch (*Sitta canadensis*), Townsend's warbler (*Dendroica townsendi*), chestnut- backed chickadee (*Parus rufescens*), and winter wren (*Troglodytes troglodytes*). Many other birds occur in this zone which are seasonal visitors or year around residents.

The mammals found in this zone include Trowbridge shrew (*Sorex trowbridgii*), vagrant shrew (*Sorex vagrans*), dusky shrew (*Sorex obscurus*), the mountain beaver (*Aplodontia rufa*), Townsend chipmunk (*Eutamias townsendii*), Douglas squirrel (*Tamiasciurus douglasii*), flying squirrel (*Glaucomys sabrinus*), deer mouse (*Peromyscus maniculatus*), long- tailed meadow mouse (*Microtus longicaudus*), and Townsend vole (*Microtus townsendii*). The beaver (*Castor canadensis*) is found in low numbers along many of the streams and rivers in this zone. The raccoon (*Procyon lotor*), and spotted skunk (*Spilogale putorius*) are two

carnivores which are only found in this zone. Other carnivores which are found in this zone are the pine marten (*Martes americana*), bobcat (*Lynx rufus*), red fox (*Vulpes fulva*), black bear (*Ursus americanus*), coyote (*Canis latrans*), and mountain lion (*Felis concolor*). Black- tailed deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) can be found in this zone with the highest numbers being found during the winter and early spring. Elk populations are the highest in the northeastern and southeastern area of the park. During the winter, mountain goats (*Oreamnos americanus*) can also be found in this zone, especially in the area around Tumtum peak in the southwestern section of the park. Native fish and amphibians are found in the lakes, ponds, streams and rivers in this zone. The fish found in the streams and lakes include rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), brook trout (*Salvelinus fontinalis*), and bull trout (*Salvelinus confluentus*). Coho and steelhead occur in the Carbon and White Rivers, Chinook may also occur in the White River. Amphibians found in this zone include tailed frog (*Ascaphus truei*), the rough-skinned newt (*Taricha granulosa*), Pacific giant salamander (*Dicamptodon tenebrosus*). The northern garter snake (*Thamnophis ordinoides*) and the common garter snake (*Thamnophis sirtalis*) are also found in this life zone. These amphibians and fish also occur in the higher elevation zones up to 6,500 feet.

3,500 to 5,000 Feet

The next zone of the park (3,500 to 5,000 feet) is characterized by its mixed forests of western white pine, western hemlock, and Pacific Silver fir. Blue grouse (*Dendragapus obscurus*) are found in this zone along with sharp- shinned hawk (*Accipiter striatus*), golden- crowned kinglet (*Regulus satrapa*), northern three-toed woodpecker (*Picoides tridactylus*), hermit thrush (*Catharus guttatus*), and yellow warbler (*Dendroica petechia*). Other birds occur in this zone depending on weather, food sources, migration, and breading season. Mammals in this zone include masked shrews (*Sorex cinereus*), Townsend chipmunk, yellow pine chipmunk (*Eutamias amoenus*), golden mantled ground squirrels (*Callospermophilus saturatus*), Douglas squirrels, flying squirrels, deer mice, and the jumping mouse (*Zapus trinotatus*). The large predators found in the lower zone are also found in this zone. The long- tailed weasel (*Mustela frenata*) and pine martin are very common in this zone. Mountain goats may be found in this area in the winter and spring. Deer and elk are common here, especially in the summer and fall.

5,000 to 6,500 Feet

The elevational zone in the park which attracts numerous visitors in the summer is between 5000 and 6,500 feet, this is where Paradise and Sunrise are located. This zone is characterized by mixed forest and subalpine meadows. The trees are primarily subalpine fir, mountain hemlock, Alaska yellow cedar, and whitebark pine and they tend to grow in clumps. The birds of this zone include the Clark's nutcracker (*Nucifraga columbiana*), common raven (*Corvus corax*), red- tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), western flycatcher (*Empidonax difficilis*), rufous hummingbird (*Selasphorus rufus*), mountain bluebird (*Sialia currucoides*), and Lincoln's sparrow (*Melospiza lincolnii*). Many of these birds can be found in other zones depending on the season. This is the zone where large numbers of elk congregate in the summer months, especially on the eastern half of the park. In this zone there are pika (*Ochotona princeps*), snowshoe hare (*Lepus americanus*), Hoary marmot (*Marmota caligata*), golden- mantled ground squirrel and yellow pine chipmunk. In the meadows are numerous pocket gophers (*Thomomys talpoides*). The most common carnivore is the pine marten. Black bear, coyote, red fox, and mountain lion visiting this zone in the summer and fall. There are large herds of mountain goats in this zone. There are numerous ponds and lakes, some of which have been stocked with rainbow, cutthroat, and brook trout. Many of the ponds have populations of amphibians including northwestern salamander (*Ambystoma gracile*), long- toed salamander (*Ambystoma macrodactylum*), and Cascades frog (*Rana cascadae*).

Above 6,500 Feet

Over 80 square miles of Mount Rainier National Park is above 6,500 feet, including 35 square miles of snow and ice. Snowfields, glaciers and bare rock outcrops, characterize this zone. There are many plant communities associated with these exposed areas. Insects and spiders are found at these elevations due to wind dispersal onto snowfields and glaciers. These organisms serve as food for numerous birds that visit the snowfields. The white- tailed ptarmigan (*Lagopus leucurus*) can be found in this zone along with the Gray-crowned rosy finch (*Leucosticte arctoa*) and the American pipit (*Anthus rubescens*).

Threatened, Endangered or Sensitive Plants

Approximately 15 rare plant species may occur in the park. None are currently federally listed. Several are considered state species of concern and the rest are considered state sensitive species. In addition, there an estimated 200 survey and manage sensitive species identified by the Northwest Forest Plan (1994). Park rare plants are listed in the table below,

TABLE 5: SPECIAL STATUS PLANTS, INCLUDING FEDERAL- AND STATE-LISTED SPECIES

Species	Status [a/] FWS	WA	Habitat Needs/Occurrence
Obscure Indian paintbrush *(Castilleja cryptantha)*	_	SS	This small (6 to 12 inches) multi-stemmed perennial plant is endemic to Mount Rainier National Park and the local area. The plant is known to exist at 25 sites in Mount Rainier and in 2 sites adjacent to the park's border. Populations are located in moist, well-drained meadows in the northern part of the park. Surveys showed that individual populations often had numerous stems/individuals but no seedlings. Based on surveys, there apparently is great variability in population trends among locations and between years.
Mount Rainier lousewort (*Pedicularis rainierensis*)	_	SS	This plant species has been observed in 34 locations in subalpine meadows throughout the park.
Lance-leaved grapefern (*Botrychium lanceolatum*)	_	SS	This plant species has been observed in three locations in the park; however, no additional information is available on locations of occurrence or habitat.
Common moonwort *(B. lunaria)*	_	SS	No information is available on locations of occurrence or habitat, although one voucher specimen of this species is in the park herbarium.
Northern moonwort *(B. pinnatum)*	_	SS	There are two voucher specimens (1888, c. 1960) of this plant from unspecified locations in the park. No additional information is available on locations of occurrence or habitat.
Little grapefern *(Botrychium simplex)*	--	SS	This plant was observed in two locations in the park in 2001.
Northern microseris *(Microseris borealis)*	_	SS	This plant species has been observed in four locations in the park; however, no additional information is available on locations of occurrence or habitat.
Wheeler's bluegrass (*Poa nervosa*)	_	SS	Surveys for this species have not been completed. Based on habitat availability, it is expected to occur in the park.
Crested wood-fern (*Dryopteris cristata*)	_	SS	Surveys for this species have not been completed. Based on habitat availability, it is expected to occur in the park.
Curved woodrush *(Luzula arcuata)*	_	SS	This plant species has been observed in one location in the park; however, no additional information is available on locations of occurrence or habitat.
Northern wild licorice *(Galium kamtschaticum)*	_	SS	This plant species has been observed in the park; however, no additional information is available on locations of occurrence or habitat.
Skunky Jacob's-ladder *(Polemonium viscosum)*	_	SS	There is one voucher specimen (1896) of this species in the park herbarium. No additional information is available on locations of occurrence or habitat.
Pygmy saxifrage (*Saxifraga rivularis*)	_	SS	There is one voucher specimen (1895) of this species in the park herbarium. No additional information is available on locations of occurrence or habitat.

Species	Status [a/] FWS	WA	Habitat Needs/Occurrence
Blackened sedge (*Carex atrosquama*)	_	SS	There is one voucher specimen (1895) of this species in the park herbarium. No additional information is available on locations of occurrence or habitat.
Tall agoseris (*Agoseris elata**)***	_	SS	Surveys for this species have not been completed. Based on habitat availability, it is expected to occur in the park.

a/ Status:

FT = Federally Threatened: Listed by the U.S. Fish and Wildlife Service as a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FP= Federal Proposed: Species for which the USFWS has proposed in the *Federal Register* listing as threatened or endangered.

FSC = Federal Species of Concern: Species whose conservation standing is of concern to the U.S. Fish and Wildlife Service, but for which status information is still needed.

SS = Washington State Sensitive: Any species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range within the state without cooperative management or removal of threats.

— = No designation

Threatened, Endangered or Sensitive Wildlife

TABLE 6: SPECIAL STATUS WILDLIFE SPECIES, INCLUDING FEDERAL AND STATE LISTED SPECIES

Species	Status [a/] FWS	WA	Habitat Needs/Occurrence
BIRDS			
Northern spotted owl (*Strix occidentalis caurina*)	FT	SE	The northern spotted owl is a medium sized nocturnal owl that preys primarily on small mammals. The owl is strongly associated with mature or old growth forests that are structurally complex – containing trees of several species, sizes, and ages, standing and down dead trees, with multistoried canopies. Moreover, the birds require large amounts of such habitat. Median home range sizes are typically on the order of 3,000 to 5,000 acres per pair. Spotted owls nest in cavities or platforms in trees, and in good habitat, pairs are typically spaced about 1–2 miles apart. Spotted owls are long-lived, territorial birds, often spending their entire adult life in the same territory. Spotted owl pairs begin to roost in February or March. In late March or early April, the female will lay 1 to 3 eggs. Young are fed by both parents until August or September, although fledging may occur in May or June and by October the young disperse from the nest site. Northern spotted owls' nesting and fledging season extends from March 1 through September 30 and in western Washington the late nesting season has been identified, beginning on July 6. Nest trees may include Douglas-fir, grand fir, Pacific silver fir and other species and are usually found in forests up to 4,800 feet in elevation. One identified nesting site on the east side of the park is in an old burn.

Species	Status [a/] FWS	WA	Habitat Needs/Occurrence

Habitat degradation and loss threaten this species with extinction. Much of the remaining habitat is highly fragmented. In addition, barred owls *(Strix varia)* have invaded much of the range of the northern spotted owl during the last 30 years and have displaced and hybridized with spotted owls (Dunbar *et al.* 1991; Thomas et al. 1993; Hamer *et al.* 1994). Since listing, Anderson and Burnham (1992) indicate northern spotted owl populations are continuing to decline throughout their range and this decline may be accelerating. Large scale analysis of the northern spotted owl over 23% of its range, including Mount Rainier National Park, indicated that populations were either relatively stable or were experiencing a decline (3.9% annually for female owls) (Franklin et al. 1999). Critical habitat for the species has been designated within Lewis and Pierce Counties, but the designation does not include lands within Mount Rainier National Park. The northern spotted owl is an uncommon year-round resident of the park (breeding between March and September), and the entire park is a congressionally reserved area for spotted owl habitat. The park contains approximately 68,000 acres of suitable habitat. Approximately 85% of that suitable habitat was surveyed between 1997 and 1998. A total of 13 pairs of adult owls, nine activity sites with at least one adult and seven fledglings were documented. In addition, six nest locations were identified and 29 birds were banded. Many known locations for spotted owls are within 1 to 2 miles of the park boundaries. They have been reported in forests along Westside Road, near the Longmire complex, at Ohanapecosh, near the Sunrise complex, along the State Route 410 corridor, and along Carbon River Road. Numerous nest activity sites have been located in the park.

Marbled murrelet (*Brachyramphus marmoratus marmoratus*)	FT	ST	The marbled murrelet is a small seabird that feeds on fish in ocean waters within 1 mile of the shore. Due to their secretive nature and cryptic coloration, information on the distribution and abundance of marbled murrelets in Washington has been

difficult to gather (NPS 1996a). Marbled murrelets nest in forested areas up to 50 miles from their saltwater foraging areas. Nest trees need to be in a stand that is open enough for them to fly through, yet the canopy must have enough cover to hide the nests from predators. Typically such conditions have only been found in old growth or later serial stands, however some younger stands with a high degree of structural diversity and limb-malforming infestations (i.e., mistletoe) may also be suitable. The marbled murrelets' threatened status is thought to be principally due to a loss of nesting habitat due to commercial timber harvesting. Forest fragmentation also may be making nests near forest edges vulnerable to predation by other birds, such as jays, crows, ravens, and great horned owls. In addition, increased human activities in forests, such as picnic grounds, can attract corvids and thus increase the chances of predation (USFWS 1991, 1992). Critical habitat for the species has been designated within Lewis and Pierce Counties, but the designation does not include lands in Mount Rainier National Park. Potential marbled murrelet habitat is distributed throughout the park, especially along major river corridors below 3,500 feet. Confirmed nesting occurs in the northwest corner of the park in the Carbon River and Mowich River drainages, and murrelets have been detected along the Nisqually River within the park. Approximately 22,000 acres of the park are considered suitable nesting habitat. The best nesting habitat is in lower old-growth forests below 750 meters. Mid-level forests (750-1450 m) have some suitable nesting habitat. The old growth forests in the park's western river valleys may be some of the best remaining nesting habitat in the southern Puget Sound area because they support large, intact stands of old-growth forest within 40 miles of the birds' marine foraging area. Limited non-systematic inventories for murrelets were conducted from 1995-1997, primarily in the northwestern portion of the park. A total of 891 murrelet detections were made in 1995, 92 in 1996 and 220 in 1997. These detections represent an unknown number of murrelets because an individual bird may be detected numerous times over the course of the monitoring season. Some of these detections, however, were identified as an indication of nesting occupancy based on observations of bird behavior on 42 occasions in 1995, 3 in 1996 and 69 in 1997. In addition, four other suspected nesting areas, based on repeated observations of murrelets exhibiting nesting behavior, were identified in 1997.

Bald eagle [b/] (*Haliaeetus leucocephalus*)	FT	ST	Bald eagles primarily occur along Washington's coast, rivers, and large lakes and reservoirs. They probably just migrate through the park. Wintering bald eagles may occur in the vicinity of Mount Rainier from October 31 through March 31. It is possible that bald eagles enter the park during the summer months to fish the sub alpine lakes; however, there is

Species	Status[a/] FWS	WA	Habitat Needs/Occurrence
			no record of bald eagles nesting in the park. Known nesting occurs outside the park's western boundary.
Northern goshawk (*Accipiter gentilis*)	FSC	SC	Generally, goshawks nest in trees in mature or old growth coniferous forests. Goshawks have been regularly observed in Mount Rainier National Park by visitors and biologists.
Olive-sided flycatcher (*Contopus cooperi)*	FSC	_	This flycatcher prefers forest edges adjacent to open areas, such as burns, montane meadows, and sub alpine parklands. This species breeds in the park.
Peregrine falcon[d] *(Falco peregrinus)*	FSC	SE	Peregrine falcons nest mainly on cliffs along rivers or near lakes. In the spring and fall, migrant peregrine falcons may be present near the park for short periods. Nesting peregrines occur in the vicinity of Tumtum Peak on the park's west side.
Ferruginous hawk *(Buteo regalis)*	--	ST	Nests in cliffs or trees; frequents arid plains and open rangeland. Ferruginous hawks are a migrant species in Mount Rainier.
MAMMALS			
Gray wolf *(Canis lupus*)	FE	SE	Gray wolves are wide-ranging carnivores that inhabit forests and open tundra. Hunting and other human activities eliminated the gray wolf from Washington by the early 20th century.
However, wolves appear to be naturally recolonizing Washington, especially northern Washington, from Canada. Mount Rainier contains ample habitat for gray wolves and abundant prey. Historically, the gray wolf was found in the park. Taylor and Shaw (1927) cite numerous observations of wolves from the late 1800s into the 1920s. There are 26 reported wolf sightings by visitors in the park's computerized database, which dates back to 1980; however, no observations have been verified by biologists in the last 80 years. The Washington Department of Fish and Wildlife, however, maintains a database of observations considered reliable, some of which have come from the east side of the park. No systematic surveys, however, have been conducted in the park.			
Canada lynx (*Lynx canadensis*)	FT	ST	In the Cascade Mountains, lynx live in the spruce-fir forests of the high mountains. Older, mature forests with downed trees and windfalls provide cover for denning sites, escape, and
protection from severe weather. The distribution and abundance of lynx tend to be tied to that of its primary prey, the snowshoe hare. Canada lynx probably never have been abundant in the lower 48 states because of a lack of lynx and snowshoe hare habitat. Their numbers also declined due to overtrapping in the 1980s and from a loss of forest habitat caused by development and urbanization, forest fire suppression, and unsuitable types of forest management. Bobcats and coyotes also have spread into lynx habitats, because packed snow trails were created by recreational activities, and the bobcats and coyotes have outcompeted the lynx for food and space.			
Although Mount Rainier has suitable habitat for lynx and snowshoe hare in subalpine forests and alpine areas below treeline, there are no confirmed reports of the species in the park since Taylor and Shaw (1927) documented lynx in the 1920s. No systematic surveys, however, have been conducted in the park.			
Grizzly bear *(Ursus arctos)*	FT	SE	Grizzly bears are omnivores that inhabit semi-open country, usually in mountain areas. They require large home ranges from 30 to 100 square miles in size (Van Gelder 1982). The park contains suitable grizzly bear habitat, but there have never been confirmed sightings of grizzlies in the park. In 1993, grizzly bear tracks were identified adjacent to the west side of the park.
California wolverine	FSC	SC	The California wolverine is a resident of high elevation

Species	Status[a/] FWS	WA	Habitat Needs/Occurrence
(Gulo gulo luteus)			coniferous forests and subalpine areas. Wolverines use vast areas for hunting, sometimes as much as 100 square miles (Van Gelder 1982). Although noted as a potential inhabitant of Mount Rainier by the U.S. Fish and Wildlife Service and thought likely to be present, the California wolverine has not been documented in the park since 1933.
Pacific fisher (*Martes pennanti pacifica*)	FSC	SE	Pacific fishers prefer dense forests with extensive, continuous canopies and complex forest floor structure, and they are often associated with wetland forests and riparian areas. Fisher

populations have declined throughout much of their range during the last half of the 19th century and the early part of this century, and they may be on the verge of extinction in Washington.

Mount Rainier contains suitable habitat for fishers, including large forage areas away from human influences, but there has been no confirmed documentation since 1947. Jones and Raphael (1991) conducted a systematic study on the abundance and habits of fishers in the southeastern corner of the park but did not detect them.

Long-eared myotis *(Myotis evotis)*	FSC	_	This species typically prefers forestlands and heavy chaparral. (Sumner and Dixon 1953). A nursing colony has been documented at Longmire.
Long-legged myotis *(Myotis volans)*	FSC	_	This bat forages over ponds, streams, open meadows, and forest clearings. Night roosts are usually in caves or mines. It has been identified as being present in Mount Rainier.

Species	Status[a/] FWS	WA	Habitat Needs/Occurrence
Pacific Townsend's big-eared bat *(Plecotus townsendii townsendii)*	FSC	SC	Townsend's big-eared bats hibernate in caves and use caves, lava tubes, and abandoned buildings for breeding and roosting sites. Nursery colonies are extremely sensitive to human activity, and sites are readily abandoned if disturbed. The bat was confirmed in the park in several locations between 2000 and 2002.
FISH			
Chinook salmon (Puget Sound "ESU") *(Oncorhynchus tshawytscha)*	FT	SC	Chinook are easily the largest of any salmon, with adults often exceeding 40 pounds. Chinook use a variety of freshwater habitats, but it is more common to see them spawn in larger main stem rivers or tributaries.

In Mount Rainier, likely habitat for Chinook salmon includes the Carbon, White, Mowich, and Puyallup Rivers, the West Fork of the White River, and Huckleberry Creek. Chinook salmon have been documented in the Carbon River.

Bull trout (*Salvelinus confluentus*)	FT	SC	Bull trout habitat is characterized by clear cold water, silt-free rocky substrate in riffle run areas, well-vegetated stream banks, abundant in stream cover, deep pools, relatively stable flow

regime and stream banks, and productive fish and aquatic insect populations. Historically, they were found in most major river systems in the Pacific Northwest. In Mount Rainier, bull trout have been documented from the White, West Fork, Carbon, and Puyallup Rivers and their tributaries.

Dolly Varden *(Salvelinus malma)*	FPROP	SC	Dolly Varden are proposed under the similarity of appearance provision of the Endangered Species Act. They occupy the same habitats and have nearly indistinguishable

Species	Status[a/] FWS	WA	Habitat Needs/Occurrence
			characteristics from bull trout.
Coho salmon (*Oncorhynchus kisuytch*)	FPROP	--	Coho were historically found in the White, Carbon, North and South Puyallup and Mowich rivers. They are likely present in small numbers in these rivers today.
Coastal cutthroat trout (*Oncorhynchus clarki clarki*)	FPROP FT	_	The USFWS listed the eastern Cascades portion of the coastal cutthroat as threatened in April 1999 . Coastal cutthroat on the west side of the Cascades were found not warranted for listing at the same time. Coastal cutthroat trout have been documented in the park; however, this documentation suggests that while this species is native on the west side, that it was introduced on the east side and was not historically present in park waters there.
REPTILES AND AMPHIBIANS			
Red-legged frog[d/] (*Rana aurora)*	_	_	The red-legged frog occurs in park low elevation (below 4,000 feet) wetlands.
Tailed frog[d/] (*Ascaphus truei)*	_	_	Tailed frogs inhabit many of the park's clear, fast-flowing streams.
Cascades frog *(Rana cascadae)*	FSC	_	Cascade frogs are a montane species, primarily occurring above 800 meters in montane meadows, marshes, and ponds (U.S. Forest Service 1995). Distribution of the Cascades frog in the park is not well known. Surveys have documented these amphibians in the Huckleberry; Carbon, Mowich; Puyallup, Nisqually, Cowlitz, Ohanapecosh, and White River.
Western toad (*Bufo boreas)*	FSC	SC	Western toads were formerly more abundant, but recently they have been found only in a few montane lakes and wetlands in the park.
Columbia torrent salamander (*Rhyacotriton kezeri*)	FSC	SC	This species has not been documented from in the park, but has been documented immediately outside the park boundary.
Larch Mountain salamander *(Plethodon larselli)*	FSC	SS	Larch mountain salamanders are found in forested and talus environments that provide cool, moist conditions under wood or rock substrates. The salamander has been found near the park boundary and in the park.
Van Dyke's salamander *(Plethodon vandykei)*	FSC	SC	Van Dyke's salamander is found in a variety of habitats, including stream banks, upland forests, talus, and seeps, at a large range of elevations. Salamanders have been documented in the Mowich drainage and just outside the park boundary near Longmire.
MOLLUSKS			
California floater (mussel) *(Anodonta californiensis)*	_	SC	Freshwater mollusks can inhabit permanent water bodies of all sizes. Mussels may also be found in sand-gravel substrates that are stable. The California floater is expected to occur in the park in suitable habitat but has not yet been documented.
INSECTS			

Species	Status[a/] FWS	WA	Habitat Needs/Occurrence
Fender's soliperlan stonefly (*Soliperlan fenderi)*	FSC	_	This species has been identified on three occasions on the west side of the park.

a/ Status:

FE = Federally Endangered: Listed by the U.S. Fish and Wildlife Service as a species that is in danger of extinction throughout all or a significant portion of its range.

FT = Federally Threatened: Listed by the U.S. Fish and Wildlife Service as a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FPROP = Federal Proposed: Species for which the USFWS has proposed in the *Federal Register* listing as threatened or endangered.

FC = Federal Candidate: Species for which the U.S. Fish and Wildlife Service has sufficient information to propose for listing as threatened or endangered.

FSC = Federal Species of Concern: Species whose conservation standing is of concern to the U.S. Fish and Wildlife Service, but for which status information is still needed.

SE = Washington State Endangered: Any species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

ST = Washington State Threatened: Any species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

SC = Washington State Candidate: Includes species that the department will review for possible listing as state endangered, threatened, or Sensitive. A species will be considered for designation as a state candidate if sufficient evidence suggests that its status may meet the listing criteria defined for state endangered, threatened, or sensitive.

SS = Washington State Sensitive: Any species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range within the state without cooperative management or removal of threats.

— = No designation

b/ Bald eagles were proposed for delisting on July 6, 2000. Delisting is expected to occur in October 2000. They will remain fully protected species.

c/ The peregrine falcon was removed from the federal Endangered Species List in August 1999 but remains a state-listed species. The Washington State Department of Fish and Wildlife recently issued a determination of nonsignificance for the reclassification of the peregrine falcon from state endangered to state sensitive species (protected wildlife - WAC 232.12.011). The comment period closed in March 2002.

d/ The red-legged frog and tailed frog have been on many USFWS service lists and so they remain on this list, although not included in the March 14, 2001 letter from the USFWS.

Prehistoric and Historic Archeology

Only a small percentage of the park has been surveyed for archeological resources. As of the 2002 field season, the park had documented 40 prehistoric and multi- component (prehistoric and historic) sites, 29 prehistoric isolated finds, and 31 historic sites and isolated finds. Most documented archeological sites (74 percent) are found within subalpine communities, with approximately 16 percent in alpine habitats. The rest (10 percent) have been found in forested habitats, where more continuous vegetative cover and deposition, makes it difficult to detect archeological remains. Of these, 75 percent of sites are found on slopes of 5 degrees or less and 75 percent are within 300 feet of water. Archeological modeling predicts the greatest intensity of prehistoric use in subalpine communities and in the upper forest margins that would have supported similar communities as recently as the last "Little Ice Age" approximately 500- 150 years ago.

The oldest confirmed dated deposits come from an estimated 3,500 years before the present. Other preserved stratigraphically dated profiles, indicate buried soil to 8,500 years ago. It is likely that the archeological record in the park will be extended to that period. Very early sites are difficult to locate, owing to burial 3- 5 feet below the surface.

The most intensive survey efforts have been associated with rehabilitation and construction related projects in the developed areas of the park (including trails and backcountry camps) during the last ten years. Less intensive reconnaissance efforts have focused on subalpine and alpine landscapes, and several forest

settings. Other survey efforts have concentrated in areas where known archeological resources have been reported. Understanding of the park's prehistoric use patterns is based on the results of these surveys, on the archeological record in the vicinity of the park, and on environmentally- based models of human subsistence and settlement patterns in mountainous environments (Burtchard 1998). Knowledge of the historical archeological record also relies on these sources, plus written records, informant accounts and historic documents.

Prehistoric archeological evidence is dominated by low to moderate- density lithic scatters, most of which are exposed on the soil surface. Dominant materials are cryptocrystalline silicate rock, most of which originated outside the park. Because of the volcano's depositional history, a relatively small fraction of the total remainder of artifacts anticipated is found on the surface. As a result, most of the material is found under the surface, providing some protection from direct fire effects, but not from firefighting effects. Historic artifacts are more likely to contain wood components and would be the most vulnerable to fire.

Historic Structures

There are approximately 158 historic resources in the park individually and collectively listed on the National Register of Historic Places. Many more sites, structures and objects are potentially eligible for the National Register. Prior to designation of the Mount Rainier National Historic Landmark District, as described below, six historic districts were designated in the park for their rustic architectural significance. These include:

- Nisqually Entrance Historic District
- Longmire Historic District
- Paradise Historic District
- Camp Muir Historic District
- White River Entrance Historic District
- Sunrise Developed Area Historic District

Each of these historic districts exhibits significant examples of NPS rustic architecture in the style of the period of its development. In addition, there are 5 National Historic Landmark buildings or building complexes that have been designated in the park. These represent the best designs of the period and, in many cases, were used as models in other National Parks for similar structures. They include:

- Longmire Community Building,
- Longmire Administration Building,
- Longmire Service Station,
- Paradise Inn, and the
- Sunrise Blockhouses/Stockade Complex.

Cultural Landscapes/Mount Rainier National Historic Landmark District (NHLD)

The Mount Rainier National Historic Landmark District was designated in 1997. This large and exceptional District, now on the National Register of Historic Places (under landscape architecture), contains 97 historic buildings and 60 historic structures (including most of the park's road system and the Wonderland and Northern Loop trails) as well as 31 other listed features. Together, these resources are considered to be the best example of park master planning in the National Park System. Collectively, they represent an important stage in National Park development history. At Mount Rainier in the 1920s and 1930s, the NPS Landscape Planning Division invented and defined modern National Park planning. Consequently, the Master Plan for Mount Rainier, completed in 1929, was the first National Park master plan developed by the NPS and it was and is considered a model of NPS planning. The degree of conformance to the plan still present in the park is outstanding. As a whole, no other collection of park roads, bridges, developed areas and trails is more completely preserved as an intact example of National Park planning and design of the period 1904- 1957. The goal, then as now, was to integrate all park systems and facilities in a unified plan that would ensure the best possible visitor experience while severely limiting how much development would be permitted in the

park (Carr 1998). The master plan was executed in the rustic style of architecture and the naturalistic style of architecture, using native materials and natural forms to blend constructed works with their environment.

The designation of a NHLD recognizes that the park does not simply contain individual historic resources, but is itself an historical park. The historic roads, trails, buildings and designed landscapes of the park together comprise a cultural landscape of national significance in American history. Twenty- nine Cultural Landscapes have been identified that occur in a variety of vegetation types on the north, south, east and west flanks of Mount Rainier. The significance of the NHLD is divided into the following size categories, which recognize contributing resources:

- Spatial organization – the composition and sequence of outdoor spaces within the district;
- Circulation – the means and patterns of movement through the district;
- Topography – the ways in which the landscape planning responds to the topographic features of the site and the modifications of that topography;
- Vegetation – the response of existing vegetation as well as the management of vegetation through pruning, removal or addition of trees and shrubs;
- Structures – all contributing structures, including roads, trails and other small scale features such as rock walls and culverts; and
- Buildings – structures intended to shelter a human activity.

Approximately one- third of the park's cultural landscapes have had Level I or Level II Cultural Landscape Inventories completed (i.e. 10 of 29). Another approximately 20 Cultural Landscape Inventories and 25 Cultural Landscape Reports are needed to document known cultural landscapes. Even so, there is a great deal of known information that has not yet been documented through these formal inventory processes. Three Cultural Landscape Reports and three Development Concept Plans also document rehabilitation treatment for 6 cultural landscapes. These would also provide information about vegetation management issues with respect to potential fire effects.

Ethnography/Native American Traditional Use

Ethnographic resources are defined as landscapes, sites, structures, objects or natural resource features that have significance based on importance attached to them by members of a socio- cultural group associated with the park. At Mount Rainier, these resources are most closely associated with at least six contemporary Native American tribes – Nisqually, Muckleshoot, Puyallup, Yakama, Squaxin Island and Cowlitz.

Based on several investigations, into the archeology, history and ethnography of Mount Rainier National Park (Thompson 1981, Catton 1996, Carr 1997, Boxberger 1998, Smith 1964, Burtchard 1998), no specific Native American use of the park has been documented to date. For thousands of years, however, Mount Rainier has been an important place and a symbolic landmark for the Native Americans. In addition to ancestral use for hunting, archeological and ethnographic evidence suggests that prehistoric people used high elevation landscapes on Mount Rainier to gather a variety of economically important resources. Among other products, gathering beargrass and cedar splits for basketry and collecting plants for medicinal, ceremonial and religious uses has been documented through 1950 (Boxberger 1998). Similar uses continue through the present.

In the park's human history it is likely that Native Americans used fire to some advantage in increasing the yield of harvestable plants well adapted to fire. Native Americans are thought to have intentionally burned upper elevation forest and subalpine areas in the Cascades and other northwest mountainous areas to improve huckleberry productivity and ungulate forage. One of the most specific references is from Forests of Mount Rainier National Park (G.F. Allen 1922) which contains the following description.

> "The old burns in the middle altitudes of the park occupy regions once frequented by the Klickitat Indians. Every summer parties of hunters and berry pickers from the sagebrush plains crossed the Cascades with their horses. They followed the high divides and open summits of the secondary ridges until they came around to the open parks about Mount Rainier where they turned their horses out to graze and made their summer camp. The women picked huckleberries and the men hunted

> deer and goats. They made great fires to dry their berries and kindled smudges to protect their horses from flies. It was also their custom to systematically set out fires as they returned. Burning made the country better for the Indians. The fires kept down the brush and made it more accessible. Deer could be more easily seen and tracked and the huckleberry patches spread more widely over the hills.
>
> No considerable part of the lower forests of the park has been burned. The principal danger is from lightning. However, few of the trees struck are ignited and these fires are usually extinguished by the rain. . ."

Over time, changes in the size, seasonality and frequency of fires have occurred as a result of human intervention, including by Native Americans. Interpretation of the extent and ecological impacts of these activities vary widely. Lightning has historically been the most important ignition factor, and will probably continue to be so.

Native American use of the park continues to this day, with some tribes possessing or negotiating agreements for the collection of specified quantities of native plants to continue cultural traditions. It is possible, perhaps probable, that significant but undocumented archeological and ethnographic resources, (including ceremonial locations) exist throughout the park in areas used by the current Native American Tribes and prehistoric use by ancestors of these peoples. Other, less known use for ceremonial or spiritual purposes also occurs but has not been well- documented.

WILDERNESS

In 1988, Congress designated approximately 97 percent (228,480 acres) of Mount Rainier National Park as wilderness. Park wilderness includes a wide array of undisturbed lands encompassing ancient rainforest, pristine rivers and brilliant subalpine meadows. Park wilderness values include natural, ecological, geological, cultural, scenic, scientific and recreational opportunities. Natural quiet and natural darkness are also considered wilderness values. In the park, the wilderness boundary generally is located 200 feet on either side of the centerline of paved roads and 100 feet from the centerline of unpaved roads. In addition, the wilderness boundary skirts developed areas by about 200 feet.

Park wilderness offers a wide array of scenic, natural and ecological values. Park wilderness encompasses the full breadth of the diverse Mount Rainier landscape of glacial ice and snow, old growth forests, river headwaters, streams and waterfalls, abundant wetlands and through flower- filled subalpine meadows and rock scree slopes with perennial snow patches. Park wilderness is and has been an ongoing object of scientific study. As the highest active Cascade volcano, exhibiting near- record snowfall and the greatest single- peak glacial system in the continental United States, the Mountain offers outstanding opportunities to understand vegetation, wildlife, fire ecology, catastrophic geologic events – including lahars, glacial outburst floods and volcanic eruptions – snow, ice and other water resources. These resources afford excellent opportunities to study ecosystem structure, function, processes and components across the breadth of this volcanic landscape.

As described above, the park is a premier National Historic Landmark District, the best example of NPS planning in the early twentieth century, the park offers an outstanding opportunity to understand park related human impacts as well as an unparalleled collection of rustic architecture and naturalistic landscape architecture. The park's human history is spread over nearly 8,500 years and offers glimpses into the distribution of people across a high mountain landscape over centuries of ecological changes in climate and topography.

Park wilderness also offers a range of recreational experiences – including camping, hiking, mountain climbing, backpacking, photography, picnicking, and a host of winter activities, including snowshoeing, cross- country skiing, sliding and snowboarding. There remain, despite heavy seasonal visitation, outstanding opportunities for solitude.

Most wilderness use occurs from June through September. During other months and summer weekdays (except during August), few people are encountered in the vast majority of the wilderness area (NPS 2001).

VISITOR EXPERIENCE

Located an hour and a half from metropolitan Puget Sound, Mount Rainier is within easy access of over 2 million people. About 80 percent of visitor use occurs between May and October (Johnson *et al*. 1990). Mount Rainier National Park is one of the most popular visitor attractions in the Pacific Northwest. In 2000, there were 1,970,406 visits. The number of visitors to the park has varied little over the last 11 years. The highest visitation in the past decade was 1992, with 2,358,296 visitors.

Visitation is highly dependent on regional weather conditions. Visitors are drawn to the park from the surrounding region when the weather is clear and the mountain is visible, particularly on weekends. Visitation figures may also be affected by other external factors, such as road construction, fires or flood damage on major access routes, or may vary due to changes in methods of counting visitors.

Visitation begins to increase in spring, peaks in July and August, and decreases substantially beginning in October. Visitation during the peak season (June through October) has regularly approached and sometimes exceeded 1 million visitors. Typically, visitors during the peak months (July and August) represent at least 40% and sometimes over half of the total annual visits.

Day use is the predominant form of visitation at Mount Rainier. According to 1993 annual visitation statistics, 38% of all overnight visitors stay in campgrounds, 30% in concessioner lodging facilities, 29% in the wilderness, and 3% in miscellaneous public facilities. Based on visitor surveys, average overnight stays were 2.1 nights at wilderness campsites, 2.5 nights at drive- in campgrounds, and 1.6 nights at an inn or lodge. Visitor surveys show approximately the same amount of overnight use in nonwilderness campgrounds and wilderness campsites.

The ability to access park areas, the range and enjoyment of visitor activities/recreational opportunities, the accessibility of information, interpretation and education, and wilderness values and experience (discussed below) are all important to the visitor experience in the park.

Information, Interpretation and Education

Public education and interpretation about fire ecology and National Park Service fire management issues is provided in a variety of ways at Mount Rainier National Park. Although not identified as a primary interpretive theme at Mount Rainier, fire ecology is considered a secondary theme and, as appropriate, is incorporated in interpretive programs, the park's education program, in publications and the park's website.

Fire Suppression, Wildland Fire Use, Prescribed Fires, Hazard Fuel Reduction and other fire management activities all require additional, targeted public information and education efforts. Educating park visitors and students about both local and national fire ecology is a part of the park's interpretive and education programs. In the education program, students learn about fire ecology and its importance in ecosystems, as well as how the NPS develops programs and policies, adapting and changing them to incorporate new scientific knowledge and experience. In addition, there has been a recent emphasis on publicizing the availability of fire related jobs in the NPS as part of the NPS career education curriculum.

In years of increased fire danger or increased use of fire management strategies by the park, there is a greater emphasis on fire education. For example, in the spring of 2001 programs were presented on the NPS and park fire management programs to schools because of the drought conditions and high fire danger throughout the state. Students researched fire, performed community service projects in their area, assisted local homeowners and citizens by clearing fire buffer zones around their homes, and educated their families and community members about fire safety. The park would continue to take advantage of such opportunities through its developing education program in local and regional schools.

Interpretive programs, including walks, talks, and evening programs, include fire ecology in virtually any in-depth discussion of forest ecology. The park continues to take advantage of materials being developed by parks with more active fire programs and incorporate these into interpretive training and public education efforts.

The park's Long Range Interpretive Plan (June 2000) calls for a potential exhibit on fire ecology at the Mount Fremont Fire Lookout, a popular day hike to a historic fire lookout. Additional opportunities for incorporating fire ecology into interpretive exhibits would continue to be evaluated.

The objective of fire information/education program is to provide the public and employees with information concerning fire management goals for the park and to prevent human caused fires. Public education to describe the natural role of fire in park ecosystems is an ongoing educational and interpretive process.

PARK OPERATIONS AND VISITOR SERVICES

Mount Rainier National Park has a complex operation that includes a variety of administrative sites in enclaves across the park landscape. There are eight primary visitor use/developed areas: Nisqually Entrance (including the Sunshine Point Campground), Longmire, Paradise, Sunrise, Carbon River, Mowich Lake, Ohanapecosh and White River. Campgrounds are dispersed throughout the park, at Sunshine Point near the Nisqually Entrance, at Cougar Rock, near Longmire, at Ohanapecosh, at White River and two less-developed campgrounds at Ipsut Creek (Carbon River) and Mowich Lake. Picnicking is located at Sunshine Point, Paradise, Longmire, Ohanapecosh, Sunrise, White River, and Carbon River and in other dispersed areas throughout the park. The 93- mile Wonderland Trail encircling the Mountain provides access to numerous wilderness camps, trail shelters and backcountry cabins. The park can be likened to a small city with respect to the provision of primary services such as water and wastewater treatment, electrical distribution, radio communications, fire, ambulance and law enforcement services, trail maintenance, paved and unpaved road maintenance, housing management, and utility system operations. A myriad of other functions, including interpretation, education and natural and cultural resources and wilderness management also are administered by the park. Concession services, including lodging, dining and gifts can be found year- round at Longmire and seasonally at Paradise and Sunrise. Visitor Centers are located at Longmire, Paradise, Ohanapecosh and Sunrise. Wilderness Information Centers are located in the town of Wilkeson, near the Carbon River/Mowich Lake area, at Longmire, and White River.

Human Health and Safety

Mount Rainier National Park has comprehensive fire and safety management programs dedicated to ensuring the safety of the public and park employees. Numerous safety measures are followed to maintain the highest safety standards possible for park employees, visitors and residents, and also for the nearby population living outside park boundaries.

Fire management fieldwork involves arduous work in difficult terrain, sometimes under adverse weather conditions. For personnel, the hazards of emergency fire suppression and wildland fire use include falling limbs and trees, smoke inhalation, burns, heat stress, use of sharp tools, power tools, risks involved with helicopter flights in mountainous terrain, and cross- country travel across rugged terrain. For visitors, residents and neighbors, the hazards of fire include the effects of smoke and the risk of fire burning across trails or boundaries. Hazard fuel reduction and prescribed fire are both activities that are pre- planned to minimize risks to human health and safety.

Health and Environmental Impacts of Air Pollution

Air pollutants associated with smoke from wildland fires are: particulates (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), volatile organic compounds (VOC), and nitrogen oxides (NO_x). Ozone, although not directly emitted from smoke, is formed as a secondary pollutant when sunlight reacts with VOCs and NO_x.

The health and environmental impacts of air pollutants (particulate matter, carbon monoxide, nitrogen oxides) related to smoke from wildland fire are described below.

PARTICULATE MATTER (PM) causes a wide variety of health and environmental impacts.

Health Effects

Many scientific studies have linked breathing PM to a series of significant health problems, including:

- aggravated asthma
- increases in respiratory symptoms like coughing and difficult or painful breathing
- chronic bronchitis
- decreased lung function
- premature death

Visibility Impairment

PM is the major cause of reduced visibility (haze) in parts of the United States, including many of our national parks.

Atmospheric Deposition

Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include:

- making lakes and streams acidic
- changing the nutrient balance in coastal waters and large river basins
- depleting the nutrients in soil
- damaging sensitive forests and farm crops
- affecting the diversity of ecosystems

Aesthetic Damage

Soot, a type of PM, stains and damages stone and other materials, including culturally important objects such as monuments and statues.

CARBON MONOXIDE (CO) can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues.

Cardiovascular Effects

The health threat from lower levels of CO is most serious for those who suffer from heart disease, like angina, clogged arteries, or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels may cause chest pain and reduce that person's ability to exercise; repeated exposures may contribute to other cardiovascular effects.

Central Nervous System Effects

Even healthy people can be affected by high levels of CO. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death.

Smog

CO contributes to the formation of smog ground- level ozone, which can trigger serious respiratory problems.

NITROGEN OXIDES (NO_x) causes a wide variety of health and environmental impacts because of various compounds and derivatives in the family of nitrogen oxides, including nitrogen dioxide, nitric acid, nitrous oxide, nitrates, and nitric oxide.

Ground-level Ozone (Smog)

Is formed when NOx and volatile organic compounds (VOCs) react in the presence of heat and sunlight. Children, people with lung diseases such as asthma, and people who work or exercise outside are susceptible to adverse effects such as damage to lung tissue and reduction in lung function.

Ozone can be transported by wind currents and cause health impacts far from original sources. Millions of Americans live in areas that do not meet the health standards for ozone. Other impacts from ozone include damaged vegetation and reduced crop yields

Acid Rain
NOx and sulfur dioxide react with other substances in the air to form acids which fall to earth as rain, fog, snow or dry particles. Some may be carried by wind for hundreds of miles. Acid rain damages buildings and historical monuments; causes lakes and streams to become acidic and unsuitable for many fish

Particles
NOx reacts with ammonia, moisture, and other compounds to form nitric acid and related particles. Human health concerns include effects on breathing and the respiratory system, damage to lung tissue, and premature death.

Small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease such as emphysema and bronchitis, and aggravate existing heart disease.

Water Quality Deterioration
Increased nitrogen loading in water bodies, particularly coastal estuaries, upsets the chemical balance of nutrients used by aquatic plants and animals. Additional nitrogen accelerates "eutrophication," which leads to oxygen depletion and reduces fish and shellfish populations.

Global Warming
One member of the NOx family, nitrous oxide, is a greenhouse gas. It accumulates in the atmosphere with other greenhouse gasses causing a gradual rise in the earth's temperature. This will lead to increased risks to human health, a rise in the sea level, and other adverse changes to plant and animal habitat.

Toxic Chemicals
In the air, NOx reacts readily with common organic chemicals and even ozone, to form a wide variety of toxic products, some of which may cause biological mutations. Examples of these chemicals include the nitrate radical, nitroarenes, and nitrosamines.

Visibility Impairment
Nitrate particles and nitrogen dioxide can block the transmission of light, reducing visibility in urban areas and on a regional scale in national parks.

GROUND-LEVEL OZONE (O_3) even at low levels can adversely affect everyone. It can also have detrimental effects on plants and ecosystems.

Health Problems
Ozone can irritate lung airways and cause inflammation much like sunburn. Other symptoms include wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities. People with respiratory problems are most vulnerable, but even healthy people that are active outdoors can be affected when ozone levels are high. Repeated exposure to ozone pollution for several months may cause permanent lung damage. Anyone who spends time outdoors in the summer is at risk, particularly children and other people who are active outdoors. Even at very low levels, ground- level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

Plant and Ecosystem Damage

Ground- level ozone interferes with the ability of plants to produce and store food, which makes them more susceptible to disease, insects, other pollutants, and extreme weather. Ozone damages the leaves of trees and other plants, ruining the appearance of cities, national parks, and recreation areas. Ozone reduces crop and forest yields and increases plant vulnerability to disease, pests, and extreme weather.

Smoke Sensitive Areas

Smoke Sensitive Areas are special areas in and near the park where elevated concentrations of pollutants from smoke may cause human health or environmental impacts. They include: local communities, Class I airsheds, threatened and endangered species activity sites, campgrounds, employee housing, trails, visitor centers, park offices, etc.

SOCIOECONOMICS

The area affected by park operations and visitor activities includes parts of four counties (King, Pierce, Lewis and Yakima). There has been a moderate, but steady increase in the regional population of this four-county area during the past decade or more. Growth in the Puget Sound area, which has a large population base, has begun to infringe on the private lands near the park boundary. Current proposals for development on private lands near the park may bring additional population increases to local communities. Over the next 20 years, the populations of these counties are projected to continue to increase.

Travel expenditures in the vicinity have also been rising, with Pierce and King counties experiencing medium increases, Lewis County experiencing the highest increases and Yakima County showing the lowest gains.

The park is bordered by an array of primarily federal and state lands, but includes a moderate amount of private lands along the northwest, west and southwest boundaries. Most of these private lands are actively managed for timber production. Much of the surrounding national forests are also managed in this way. Other national forest lands include late successional reserves and wilderness areas, including the Glacier View, Clearwater, William O. Douglas and Tatoosh wilderness areas adjacent to the park boundary.

Local gateway communities range in size, but most are relatively small and somewhat dependent on park visitors for, at least, seasonal economies. Area communities include Elbe, Ashford and (farther afield) Eatonville on the southwest; Packwood on the south; Wilkeson, Carbonado and (farther afield) Enumclaw, on the northwest; Greenwater on the north; and Naches on the east. In most cases, these communities provide a minor to moderate degree of lodging, food services and other recreational opportunities for park visitors. The park is also within easy driving distance (1- 2 hours) of the Seattle- Tacoma metropolitan area. Park visitation statistics show most visitors from the Puget Sound region or other areas within the State of Washington. The next largest array comes from the West Coast, with other national and international visitors trailing these in overall numbers.

A wide range of recreational opportunities awaits the willing park visitor, including those within adjacent national forests (Mount Baker- Snoqualmie and Gifford- Pinchot national forests). Mount Saint Helens National Volcanic Monument is within easy driving distance, as are an array of smaller recreational opportunities offered on state and private lands within the vicinity of the park. These include: Northwest Trek, a northwest wildlife park, ski trails, two major ski areas, dispersed snow play areas, and a variety of other recreation sites, including Alder Lake Park (Tacoma City and Light), Elbe Hills State Forest, and Tahoma State Forest.

Finally, the park itself is a center of some commercially based operations including two major concessions, Guest Services, Inc. (offering food, lodging and gifts), and Rainier Mountaineering, Inc. (offering guided

mountaineering and other wilderness experiences). Approximately twenty other concessions permits and incidental business permits also operate out of the park (including the provision of firewood for front-country campers and other guided climbing).

ENVIRONMENTAL JUSTICE

As called for by Executive Order 12898, analysis of environmental justice includes involving populations of people who might be affected by an agency's proposal in planning related to the proposal to ensure that potentially disproportionate effects may be addressed. While there are no current plans or projects undertaken by the park that would have disproportionate effects on low- income or minority populations, it is appropriate to note that fire suppression activities in the park under Alternative 1 have had a cumulative effect in altering native plant communities adapted to fire (Calvert 2003). Native Americans were formerly dependent on these plant communities within and outside the park (ibid.). Ongoing establishment of communication with Native American Tribes concurrent with increased understanding of the ecological role of fire in the park landscape has led to an improved understanding of the use of these resources in both historical and modern contexts. In the past few years, the park has sought to establish government to government relationships with area tribes, including the Nisqually, Muckleshoot, Puyallup, Yakama and Cowlitz and has begun to acquire a deeper understanding of Native American concerns with respect to fire and vegetation management.

X. ENVIRONMENTAL CONSEQUENCES

Methodology

The environmental consequences for each impact topic were defined based on the following information regarding context, type of impact, duration of impact, area of impact and the cumulative context.

All Impacts

Context: Setting within which impacts are analyzed – such as the project area or region.

Type of Impact

Beneficial: Reduces impact being discussed.
Adverse: Increases or results in impact being discussed.

Direct: Caused by and occurring at the same time and place as the action
Indirect: Caused by the action, but occurring later in time at another place or to another resource.

Duration of Impact

Short-term: Associated with a specific event, less than five years
Long-term: Occurs continuously based on normal activity or for more than five years.

Area of Impact

Localized: Detectable only in the vicinity of the activity
Widespread: Detectable on a landscape scale

Cumulative

Context: Cumulative impacts are the effects on the environment that would result from the incremental impacts of the action when added to other past, present and reasonably foreseeable future actions. Impacts are considered cumulative regardless of what agency or group (federal or non- federal) undertakes the action.

Soils, Vegetation, Wildlife, Visitor Experience, Wilderness and Park Operations Impacts

Intensity of Impact

- **Negligible**: Measurable or anticipated degree of change would not be detectable or would be only slightly detectable.
- **Minor**: Measurable or anticipated degree of change would have a slight effect, causing a slightly noticeable change of approximately less than 20 percent compared to existing conditions.
- **Moderate**: Measurable or anticipated degree of change would be noticed by most people and would likely be between 21 and 50 percent compared to existing conditions.
- **Major**: Measurable or anticipated degree of change would be substantial, causing a highly noticeable change of approximately greater than 50 percent compared to existing conditions.

Special Status Species

Intensity of Impact

- **No Effect** — The project (or action) is located outside suitable habitat and there would be no disturbance or other direct or indirect impacts on the species. The action will not affect the listed species or its designated critical habitat (USFWS 1998).
- **May Affect, Not Likely to Adversely Effect** — The project (or action) occurs in suitable habitat or results in indirect impacts on the species, but the effect on the species is likely to be entirely beneficial, discountable, or insignificant. The action may pose effects on listed species or designated critical habitat but given circumstances or mitigation conditions, the effects may be discounted,

insignificant, or completely beneficial. Insignificant effects would not result in take. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not 1) be able to meaningfully measure, detect, or evaluate insignificant effects or 2) expect discountable effects to occur (USFWS1998).

- **May Affect, Likely to Adversely Effect** — The project (or action) would have an adverse effect on a listed species as a result of direct, indirect, interrelated, or interdependent actions. An adverse effect on a listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions and the effect is not: discountable, insignificant, or beneficial (USFWS 1998).

Archeology/Ethnography/Historic Structures/Cultural Landscapes

Intensity of Impact

- **No Effect**: The action will not affect a historic property or the characteristics of a property that may qualify it for inclusion in the National Register of Historic Places. The action would also not, based on conditions of approval, likely result in impacts to presently unidentified cultural resources.
- **No Adverse Effect**: An undertaking has an effect on a historic property when the undertaking may alter characteristics of the property that may qualify the property for inclusion in the National Register (FR 51:169 1986). For example, the action may result in diminishing the character- defining features or aspects of a historic structure that make it eligible for the National Register, but the actions are consistent with the Secretary's Standards for the Treatment of Historic Properties.
- **Adverse Effect**: An undertaking is considered to have an adverse effect when the effect on a historic property may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling or association(FR 51:169 1986). In other words, the effects on character-defining features or aspects of a historic structure would result in diminishing or removing the characteristics that make it eligible for the National Register of Historic Places and as a result would not be consistent with the Secretary's Standards for the Treatment of Historic Properties.

Impacts of Alternatives on Park Resources

Air Quality

Ecological Effects of Fire on Air Quality and Air Quality Related Values: Smoke from wildfires and prescribed burning is a complex mixture of carbon, tars, liquids, and gases. The major pollutants are particulates, volatile organic compounds (VOCs), and carbon monoxide (CO). Nitrous oxide (NO_x) is also produced, but in a relatively small quantity when compared to other pollutants. Particulates can remain suspended in the atmosphere for a few days to several months, and can reduce visibility as well as contribute to respiratory problems. Very small particulates can travel great distances and add to regional haze problems. Regional haze can also result from multiple burn days and/or multiple owners burning within an airshed over too short a period of time to allow for dispersion.

To quantify the smoke emissions predicted to result from each of the alternatives considered in the FMP, a smoke management modeling system such as the First Order Fire Effects Model 5.0 (FOFEM), BlueSkies or NFS Puff would be used to plan Prescribed Fires (Alternatives 3 and 5) or to determine whether Wildland Fire Use (Alternatives 2- 5) is an appropriate management strategy. FOFEM is a computer- based planning tool that is used to provide quantitative predictions for planning prescribed fire, for impact assessment, and for long- range planning and policy development. FOFEM and other smoke prediction/management tools are designed to provide quantitative fire effects information for tree mortality, fuel consumption, mineral soil exposure, and smoke. FOFEM generated emission factors for particulate matter less than 2.5- , and less than 10- micrometers ($PM_{2.5}$, PM_{10}), VOCs (as CH_4), CO, and Carbon Dioxide (CO_2). NO_x was calculated using the Environmental Protection Agency (EPA) AP- 42 standard that states NO_x emissions are approximately 35 times less than those of CO emissions for wildland fires. Using smoke management modeling correlated with vegetation or fuel model types is important to understand smoke related impacts from fire management activities.

The following smoke management mitigation measures would be employed under any fire suppression, use or prescribed fire (see below) alternative:

- Limiting the number of acres and amount of fuel burned;
- Assessing timing and method of ignition;
- Determining the moisture content of fuel;
- Increasing communication, cooperation and coordination with adjacent agencies and landowners regarding fire; and
- Coordinating with other agencies and land owners to limit the number of fires occurring simultaneously.

In addition, the FMP would comply with all federal and state regulations governing air pollution and smoke management standards and all applicable NPS policy and guidelines related to wildland fire management and ecosystem health.

Alternative 1 Air Quality Impacts

Wildland Fire Suppression: Under the current program of fire suppression, short- term minor to moderate air quality impacts would continue to occur from fire management activities. Normally, smoke impacts to the park and surrounding communities would be minimized since most fires would be kept relatively small because most would have immediate fire suppression actions taken (depending on whether the suppression strategy was to control the fire – put it out immediately, or to confine and contain the fire – limit it to a predetermined perimeter or area). Even small lightning strikes encompassing one tree could result in an initial attack response. Some fires, however, would likely escape initial attack and some fires upon initial attack would be placed under a confinement strategy and would gain in size and consequently would release more particulates. Particulate increases from fires under this alternative would remain small, typically lasting only a few hours or a few days, dependent on fire containment and mop- up. Due to the inaccessibility of some park terrain and the high fuel moisture levels normally present, however, some of these fires might smolder for days or weeks before detection.

Smoke from even immediately suppressed fires could reduce localized or widespread visibility in the park or it can temporarily degrade regional air quality. The extent of impact to visibility would depend on the fire size, duration and location. Most small fires would produce localized visible smoke in the general vicinity of the fire. Larger fires could impact visibility over a larger area or could carry large amounts of smoke downwind, resulting in views being obscured over a large watershed or section of the park. Temperature inversions, which often form in valleys at night, could trap smoke until daytime warming improves air circulation. As a result, visibility impacts would likely be greatest in the early morning and early evening.

According to Agee and Huff (1980) in a study in Olympic National Park, crown fires typically produce higher emissions than surface fires. Crown fires may occur at any time, but (as in the example described under *Fire Behavior* above) may occur when considerable snow is still on the ground.

Hazard Fuel Reduction (Limited Debris Burning): As mentioned, if there is no other forest residue disposal alternative (as articulated in the description of Alternative 1 and Office Order 83- 2) debris burning is permitted upon meeting the following conditions. Burn piles would be small, up to about six feet in diameter, and would consume less than 100 tons of material in a 24- hour period. When and if burning is permitted, it would be done according to the regulations established by the Puget Sound and Southwest Clean Air Agencies, and the Washington State Departments of Natural Resources and Ecology, and in compliance with the State of Washington Smoke Management Plan, and/or by advanced written permission after individual Prescribed Fire environmental analysis. Only natural vegetation may be burned (burn piles must be free of milled lumber and other foreign objects). In addition, the following conditions to minimize air quality impacts, the potential for fire escape and safety hazards would be met:

- No or limited (as appropriate pending consultation) burning would be conducted when air regulatory agencies declare air pollution episodes and impaired air conditions for Pierce or Lewis County.
- Park personnel would obtain updated burning information (1- 800- 323- BURN) on the day of the burn and follow the instructions that apply for the day and location of the proposed burning.
- To limit impacts to visitor use, burning would primarily occur during the week when conducted from Memorial Day to Labor Day.
- All materials earmarked for burning would be placed in clearly marked piles at designated burn areas, such as the Kautz Creek maintenance area or Ohanapecosh Wastewater Treatment Plant, where proper signage to identify and describe what materials are placed there for burning is necessary.
- Burn piles would be located at least 50 feet from structures.
- As appropriate, flammable debris would be cleared from the area.
- Burning would only be conducted during periods when adjacent fuel moisture was high (with an ignition component of less than 50 percent) and winds were calm or light.
- Adequate suppression equipment and personnel would be on hand (a connected water hose, or at least five gallons of water and a shovel available nearby).

As a result, there would be short- term, minor air quality impacts as debris burning was periodically implemented. No smoldering fires would occur overnight and thus most impacts would be limited to a single day or period of several days, if a large quantity of material were burned. Information and potential human health impacts would be limited by the prohibition on burning anything other than natural forest residue (i.e. no treated wood or other materials would be burned). Because the hazard fuels reduction program is small under this alternative, there is a greater risk from fires potentially escaping initial attack and producing larger amounts of smoke.

Hazard Fuel Reduction (Limited Manual/Mechanical Treatment): Under this Alternative, Manual/Mechanical Treatment would result in negligible localized particulate emissions (dust and exhaust), primarily in developed areas and along roadsides related to implementation. Work would be done either using hand tools or mechanized equipment, including chainsaws and some use of heavy equipment in developed areas and along roads. There would be a negligible to minor long- term benefit as a result of the employment of Hazard Fuel Reduction near structures.

Alternative 2 Air Quality Impacts

Wildland Fire Suppression: Under this alternative, air quality impacts related to Fire Suppression would be similar to Alternative 1. The only difference would be that some naturally ignited wildland fires would be managed under the Wildland Fire Use Strategy with impacts related to use of that strategy defined below. No hazard fuel reduction (either debris burning or Manual/Mechanical treatment) would occur under Alternative 2. Therefore, there would be no impacts related to these fire management strategies.

Wildland Fire Use: Impacts related to implementation of a Wildland Fire Use strategy would be expected to be moderate and could be less than or greater than those associated with only Wildland Fire Suppression. Under this Alternative, fires would likely be allowed to grow somewhat larger before they would be extinguished via suppression, if the project exceeded prescription or natural weather and fuel conditions. Dependent on fire location, size, spread, resource values at risk and other factors, management of a wildland fire use would require appropriate suppression actions that could include keeping the fire out of heavy fuels if it would produce too much smoke, keeping it away from sensitive resources, keeping it from burning buildings, etc. As mentioned, the actual size and number of fires would depend on prevailing weather patterns, the location of lightning strikes, and the extent of fire spread before naturally extinguished (via weather conditions or fuel breaks or discontinuities) or suppressed.

Since, under this Alternative, there could be one or more fires burning at the same time, overall impacts of these fires would depend on their size, intensity and duration, but could result in a widespread regional haze or a column of smoke over the fire, with a light to moderate haze spreading over the park, dependent on wind direction. Several smaller fires would likely result in less obvious smoke production impacts than would one large fire under full suppression. Similar to Wildland Fire Suppression fire starts, and depending again on location and intensity, most particulate matter would begin to fall out prior to reaching the park boundary or adjacent communities. Although naturally ignited wildland fires are relatively uncommon in the park, it is expected that the number of acres burned under the Wildland Fire Use strategy would be somewhat to moderately greater than the acres burned only using a Wildland Fire Suppression strategy. Emissions would therefore increase proportionally. Larger fires could result in moderate to major emissions and visibility impacts for longer periods of time. The largest smoke impacts would likely result from crown fires. Overall, air quality impacts would be short- term and would diminish, as the fire was extinguished, dependent on seasonal air movement.

Smoke management concerns would be addressed during Wildland Fire Use by working with the Washington State agencies responsible for implementation of the Clean Air Act. Wildland Fire Use situation analysis would take into account regional and national conditions related to air quality management with respect to other fires burning nearby, either in the park or within the State. Unacceptable smoke impacts could result in discontinuation of the Wildland Fire Use strategy for some fires. As in Alternative 1, air quality impacts to human health are discussed later.

Alternative 3 Air Quality Impacts

This Alternative would have the same Fire Suppression impacts as Alternative 1 and the same Wildland Fire Use Impacts as Alternative 2.

Prescribed Fire: The primary difference would be that in this alternative, conducting Prescribed Fires to meet resource objectives would result in an additional minor to moderate degree of air quality impacts, including particulate emissions and diminished visibility. As with Wildland Fire Use, these impacts would be localized and would be limited in scope and effect. Fires that did not meet prescriptions would not be ignited or would be suppressed. Each fire would be managed within a predetermined area as described above, and as a result would be relatively small under park projected uses. Most would be conducted as either research burns to achieve specific resource objectives, for instance to remove fine fuels in the white bark pine community to stimulate natural regeneration of this species, or as actions to increase defensible space around developed areas with sensitive administrative or cultural resources. Analysis here is necessarily brief and deferred by the lack of Prescribed Fire planning in the park. Upon development and peer review, park prescribed fire plans would undergo individual environmental analysis, including public review.

Alternative 4 Air Quality Impacts

This Alternative would have the same Fire Suppression air quality impacts as Alternative 1 and the same Wildland Fire Use impacts as Alternative 2.

Hazard Fuel Reduction air quality impacts, however, would be negligible to minor and localized, but would be somewhat greater in this alternative than in Alternative 1, because they would be carried out under a more systematic strategy (via the Hazard Fuel Reduction and Cultural Resources Maintenance Plan). Although, as mentioned above, the same area would be targeted for treatment, the treatment would be more comprehensive. For instance, removal of dead or downed limbs would be more thorough and would be conducted regularly, potentially resulting in a greater need to burn debris piles. In addition, there would be a small degree of increased use of mechanized equipment to carry out Hazard Fuel Reduction in developed areas. Whereas little or no Hazard Fuel Reduction now occurs around wilderness buildings, such actions would be planned and carried out regularly, appropriate to the significance of the building and its landscape characteristics.

Alternative 5 Air Quality Impacts
This Alternative would result in the same short- term minor to moderate with periodic major Fire Suppression impacts as Alternative 1; the same short- term minor to moderate Wildland Fire Use impacts as Alternative 2; and the same short- term minor to moderate Prescribed Fire impacts as Alternative 3. The negligible to minor Hazard Fuel Reduction impacts of Alternative 4 might be further reduced by using selective debris burning of accumulations of fuel collected in developed areas. This would also have a negligible beneficial effect by reducing air quality emissions since it would decrease the need for prescribed fire in developed areas.

Summary/Cumulative Impacts: There would be short- term minor to moderate, with periodically major impacts, associated with wildland fire suppression (Alternatives 1- 5) and wildland fire use for resource benefits (Alternatives 2- 5). The extent of these impact would primarily be localized or regional, but would depend on the fire size, duration, intensity, location and other factors. Hazard fuel reduction (Alternatives 1, 4- 5) would result in short- term minor to moderate localized impacts (debris burning) and negligible localized particulate emissions (manual/mechanical treatment). Prescribed fire (Alternatives 3 and 5) could add an additional minor to moderate degree of particulate emissions and diminished visibility. Decades of fire suppression have resulted in minimal air quality emissions in northwest forests related to fire. Over time, the reinitiated use of fire would result in periods of diminished visibility and air quality but would not result in long- term cumulative impacts because pollutants would disperse readily with ambient mass air movement. The above described range of potential impacts (Alternatives 1- 5) would not impair park air quality or air quality related values or the values for which these have been protected in Mount Rainier National Park.

Soils
Ecological Effects of Fire on Soil: Soil is an integral component of terrestrial ecosystems. Fire interactions with soil are significant because most fires spread by combustion of organic matter in contact with, or part of, the soil. Fire creates physical, chemical, and biological changes that may be either desirable or detrimental in the context of long- term soil productivity.

Fire may cause changes in organic horizons, water repellency, infiltration capacity, porosity, structure, temperature, hydrologic properties, and may increase or decrease erosion. Fire generally, however, increases the potential for accelerating erosion through its effects on vegetation, organic matter, and the physical properties (including limiting water infiltration) of the soil. In the absence of vegetative cover, dry raveling can increase on steep slopes after fire.

When fires burn at high temperatures, the extreme heat from the fire can produce water repellent soil, therefore increasing the potential for runoff. Burning wood hydrocarbons, which diffuse both up in smoke and down through the soil, causes water repellant soils. Hydrocarbons moving down sometimes coat soil particles with wax, causing them to repel water. In combination, these can create a fairly hostile environment for plant growth.

Soil is a poor conductor of heat, with the upper layers of soil absorbing the greatest impact of the fire. Temperatures can be 1000 degrees F at the surface and 400 degrees F only 1 inch below. At these temperatures soil microorganisms may be killed, resulting in a temporary increase in availability of soil nutrients to plants. Soil microorganisms, however, quickly recover. Burning at high temperatures also results in the textural changes in soil structure, including compaction, as well as in the consumption of any soil organic matter. When fire blackens the soil surface and removes plant cover shading, it can greatly increase surface temperatures.

Changes in soil composition are usually the result of the volatilization of elements during combustion of fuel and organic matter. Nutrients in the soil are also lost as ash via air currents, convection or as a result of leaching through the soil. Changes in nitrogen availability, due to volatility at low temperatures, are usually

considered the most important. Burning can decrease total nitrogen availability at a site while increasing nitrogen available for plant growth.

All fire, whether natural or human- caused, would change the cycling of nutrients and the physical and biotic characteristics of soils. The magnitude and longevity of these effects depends on many factors including fire regime, fire severity, vegetation type, soil type, topography, season, and pre- and post- fire weather conditions. Fire effects may also be indirect through changes in soil biota and changes in erosion rates.

Fire impacts to soils are greatly dependent on fire severity. Most fires result in low to moderate severity. As a result, the soil structure remains relatively intact, with incomplete burning of litter and duff layers. Seed banks often remain viable and are released as a result of the increased flush of nutrients, light and water. High severity fires result in greater soil impacts but these impacts are dependent on the soil type, vegetation community, slope, aspect, weather and other factors.

Alternative 1 Soils Impacts

As described above, there would be minor to moderate adverse and beneficial natural ecological impacts to forest and subalpine soils depending on the timing, location, extent and severity of the fire. These would include an increased potential for erosion with the removal of plant cover, changes in soil composition, texture and water infiltration capability, increased nutrient availability for plants (resulting in a flush of plants naturally adapted to these conditions), etc. The removal of plant cover may result in downstream flooding and debris flows which, in turn, may result in increased soil (and nutrient) loss. There would be a short to long- term benefit to soil nutrient reserves by the release of nutrients to ash deposited during fires, resulting in increased natural fertilization of the soil and attendant increases in soil capacity to grow vegetation. Incomplete burns and wind deposits of ash would result in increased organic matter in area soils, resulting in overall soil nutrient enrichment. The added organic material would work in combination with dead and dying root systems to make the soil more porous, better able to retain water, and less compact, while increasing needed surface area for essential microorganisms, mycorrhiza and roots (Vogl 1979, Wright and Bailey 1980). Under Alternative 1, overall soil impacts would tend to be less extensive than in other Alternatives, where the Wildland Fire Use or Prescribed Fire would be used, since the intent under this Alternative would be to suppress all fires as soon as they started or were located. As in the past, there would likely be a few fires in the park that would smolder undetected for weeks, due to inaccessibility of terrain limiting their detection.

Fire Suppression: Fire suppression activities, including fire line construction, initial fire attack, the use of heavy equipment (in non- wilderness areas), mop- up activities, and human impacts from fire camps, and entering previously undisturbed areas would all result in an increased potential for soil erosion, especially on steep and or unstable slopes. In addition, vegetation removal for fire line construction, including tree removal would weaken soil holding root systems. These impacts would gradually increase erosion potential if rehabilitation of fire lines did not occur. Even rehabilitation of fire lines, by reducing compaction, could result in an increased potential for soil erosion. These impacts from fire suppression could far outweigh the impacts on soils resulting from other alternatives. Overall soil effects would be negligible to moderate depending on the timing, location, severity and extent of the fire.

Mitigation: To the degree possible, the impact of fire suppression activities on soils would be mitigated by the use of the following best management practices and minimum impact suppression tactics (MIST) (see FMP Appendix 23) whether in wilderness or in developed natural areas.

- Selecting procedures, tools and equipment with the least possible impact to the environment;
- Implementing the use of water (bucket drops or wet- lining) as a fire suppression technique;
- Ensuring that firefighting equipment is well maintained to prevent spills of lubricants, fuels or other materials (as well as using ground cloths beneath such equipment to prevent accidental releases);
- Allowing the fire to burn to a natural barrier;

- Using the minimum necessary depth and width on fire line construction;
- Covering fire lines with organic material as part of the rehabilitation process;
- Installing water bars or other silt protection measures in sensitive areas;
- Minimizing the felling of trees and bucking of downed logs along the fire line and within the perimeter of the fire;
- Minimizing the limbing of vegetation adjacent to the fire line;
- Removing or cutting vegetation only as necessary to prevent fire spread;
- Limiting the locations of fire camps, helispots, hand lines, intensive mop- up and other concentrated fire activities to non- sensitive sites;
- Leaving standing dead trees (snags);
- Using native materials for sediment traps;
- Using existing spike camps or camping in resilient areas (rocky or sandy soils) showing signs of recent human disturbance (while avoiding wet meadows, water shorelines and other sensitive areas);
- Avoiding the use of rehabilitated fire line as a travel corridor to minimize soil compaction;
- Lessening soil disturbance by ensuring that hot spots and smoldering fires are out;
- Refraining from creating piles of debris to burn or excessively spreading burning fuels, letting fuels burn out naturally;
- Using mulch or soil netting, as appropriate, to minimize or prevent erosion.

Hazard Fuel Reduction (Limited Debris Burning): Since this activity would occur only within the designated areas under this Alternative, there would be negligible, but long- term impacts to soil as a result of repeated burning in a predefined area.

Hazard Fuel Reduction (Limited Manual/Mechanical Treatment): Reducing hazardous accumulations of fuel around structures in the current management strategy would continue to have negligible to minor effects on area soils due to its limited implementation. Soil effects would be negligible and primarily related to compaction as hand and mechanical removal of vegetation occurred in developed areas where human impacts are already apparent.

Alternative 2 Soils Impacts

Under this Alternative, impacts related to wildland fire suppression would be similar to those in Alternative 1. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park soil resources.

Wildland Fire Use: This strategy would result in a minor to moderate increase (over Alternative 1) in the extent of park landscape that would be burned, depending on weather conditions, fuel moisture and other factors related to the incidence of lightning strikes and their potential to grow or go out. As a result, this Alternative would also result in an increase in the number of acres that would be subjected to wildland fire suppression activities. Therefore, there would be minor to moderate impacts to area soils as a result of wildland fire suppression activities and Wildland Fire Use. The range and type of impacts would be the same as those described above under *Ecological Impacts of Fire* and *Fire Suppression* in Alternative 1. Initially, however, the impacts of Wildland Fire Use would be somewhat greater since the return of Wildland Fire Use would be after an absence of some 50- 100 years. Areas that would have burned during the lengthy fire suppression period would therefore likely have a higher degree of fuel build- up. This would be truer of the east side of the park, and in certain vegetation types where fire return intervals are more frequent than on the west side. On steep or erosion prone slopes vegetation loss could lead to an increased potential for localized soil erosion. There would be a long- term ecological benefit to park soil resources by the return of fire to natural incidence and frequency, especially where fire suppression activities have limited the natural ecological role of fire. This alternative could also result in fewer suppression impacts to soils.

Alternative 3 Soils Impacts

This Alternative would have the same Fire Suppression impacts as Alternative 1 and the same Wildland Fire Use Impacts as Alternative 2. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park soil resources.

Prescribed Fire: Adding Prescribed Fire to the Fire Suppression and Wildland Fire Use strategies would likely result in a negligible additive effect of increasing the area that where park fires would occur over time. Overall, there would be a negligible increase in the scope and degree of ecological impacts to soil, as described above under Alternative 1. As described above, under the air quality analysis of prescribed fire impacts for Alternative 3, each fire would be managed within a predetermined area and would be relatively small. Most would be conducted as either research burns to achieve specific resource objectives or as actions to increase defensible space around developed areas with sensitive administrative or cultural resources.

As in other prescribed fire analysis in this Environmental Assessment, analysis here is necessarily brief and deferred by the lack of Prescribed Fire planning in the park. Upon development and peer review, park prescribed fire plans would undergo individual environmental analysis, including public review and site specific soils impacts would be analyzed.

Alternative 4 Soils Impacts

This Alternative would have the same Fire Suppression impacts as Alternative 1 and the same Wildland Fire Use Impacts as Alternative 2. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park soil resources.

Hazard Fuel Reduction (debris burning) impacts would be similar to, but negligibly more extensive than Alternative 1. With a more comprehensive Hazard Fuel Reduction program in place, additional days of debris burning would necessarily occur, however these would occur in the same locations as in Alternative 1 and would be limited to park established guidelines for debris burning, including pile size.

Hazard Fuel Reduction (Manual/Mechanical treatment): Under this Alternative, compared to Alternative 1, there would be an increase in the effectiveness of the fuel reduction treatment and an increase in the overall area treated. This would result in potentially minor increase in soil compaction impacts related to using heavy equipment in developed areas, such as along roadsides, to effectively reduce hazardous accumulations of fuels but a negligible increase in other areas where hand tools, including chain saws might be used. Few other impacts to soils would be anticipated under this fire management strategy.

Alternative 5 Soils Impacts

This Alternative would result in the same Fire Suppression impacts as Alternative 1, the same Wildland Fire Use impacts as Alternative 2, and the same Prescribed Fire impacts as Alternative 3. It could however result in slightly different Hazard Fuel Reduction impacts than in Alternative 4. That is, a long- term slight beneficial impact could result from a more comprehensive program of hazard fuel reduction in developed areas where sufficient clearance of debris was obtained by potentially reducing or eliminating the need for the limited use of prescribed fire use in these areas. As a result there would be a negligible decrease in the impacts of fire on soils (especially with respect to increasing soil temperature over a much smaller location) than would a broader application of Prescribed Fire in developed areas. The use of selective debris burning of accumulations of fuel collected in developed areas would also have a minor beneficial effect in increasing the ability to control the fire. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park soil resources.

Summary/Cumulative Impacts: Wildland Fire Suppression, Wildland Fire Use and Prescribed Fire would result in minor to moderate adverse and beneficial ecological impacts on forest and subalpine soils depending on the timing, location, extent and severity of the fire. Hazard Fuel Reduction (debris burning) would likely result in negligible localized impacts as repeated burning occurred in one area. Hazard Fuel Reduction (manual/mechanical treatment) would likely result in some soil compaction near developed areas

where heavy equipment could be used to reduce vegetation buildup but would not affect wilderness. Restoring fire to the park landscape, whether prescribed, wildland fire use or catastrophic would result in some negligible to minor adverse short- term impacts depending on the severity of the fire and other factors, and would result in long- term cumulative beneficial impacts by restoring nutrients to the soil which would then be available for plant growth and in turn, wildlife consumption. The above described range of potential impacts (Alternatives 1- 5) would not impair park soils or the values for which they have been protected in Mount Rainier National Park.

Water Resources

Ecological Effects of Fire on Water Resources: Water quality, water quantity, wetlands and floodplains can all be affected both by fires and by fire management activities. In general, there are few benefits to water quality following fire. Postfire soil erosion may transport soil and ash into watercourses. These nutrients have the potential to result in blooms of algae. The alkaline nature of ash may result in pH changes to water quality. Plant communities near water may withstand or be removed by fire. If removed, increased water temperatures may result, due to limited shading and increased nutrient cycling, therefore decreasing the availability of oxygen to fish and other aquatic organisms. There may be less organic material available to decrease runoff and downstream flooding may occur. Additional erosion of ash and soil may result in gullying and loss of topsoil, which may result in aggradation of the stream channel and temporarily alter water depths. In addition, a short- term flush of sedimentation in river and stream channels often occurs after the first rains. Alternatively, downstream scouring may result from flooding. Such flooding may cause debris flows that result in substantial loss of soil and alteration of water resources, including stream channel movement and vegetation removal or change in floodplains.

Small fires and fires of low intensity or those located distant from water resources would be expected to have very little effect on water quality. Fires that become large (because they escape initial attack or because they are managed as Wildland Fire Use actions), could have short- term effects on water quality in a sub-drainage or drainage due to increased ash and woody debris deposited into waterways. This type of deposition could increase turbidity downstream from the fire. Loss of vegetation could lead to increased erosion and sediment loading in surface water resources in the park. During the rainy seasons following a large fire, there would also be a potential for mudslides to deposit larger amounts of sediment into waterways. These naturally occurring, short- term minor to moderate effects would not be expected to cause long- term detrimental effects to water quality, wetlands or floodplains.

On a case- by- case basis, mitigation methods would be implemented to limit sedimentation into waterways, particularly if the fire occurs shortly before salmon spawning season, or if a wet weather system is due shortly. Resource advisors would be consulted as to the necessity for mitigation methods to lessen the impact on water quality.

Water Quality

Alternative 1 Water Quality Impacts

Generally, ecological effects of fire on water quality would be negligible to minor. Depending on its location, severity and extent, a fire, would result in the same range and type of impacts as described above. These impacts include background erosion of burned areas into water, changes in water temperature, water chemistry and other properties. Under Alternative 1, overall water quality impacts would tend to be less extensive than in other Alternatives (where Wildland Fire Use or Prescribed Fire would be used) since the intent under this Alternative would be to suppress all fires as soon as they started or were located. In the short- term, this would result in the smallest possible fire sizes although in the long- term fire size would be more extensive (because catastrophic fires would be more likely to occur).

Fire Suppression: There would be negligible to minor impacts to water quality. Fire line construction and use of park water sources for firefighting could result in localized soil erosion and subsequent deposition of soils into watercourses. The risk of this impact is greater along steep- sloped banks or hillsides adjacent to streams. While the use of chemical fire retardant, foam and gasoline would be avoided near park water

resources, such retardant could potentially enter waterways via soil erosion. No cross contamination of water bodies from fire retardant chemicals would result since bucket and fire retardant use would be separate to ensure the protection of water quality. Water would either be drawn from park waters via buckets or pumped from rivers or streams. The effect of chemical retardant and foam would result in fertilization and thus short flushes of higher nutrient levels in water and soils. The ammonia and phosphates contained in retardant could change localized water quality enough to be lethal to fish and other aquatic organisms if release occurred. Foams contain detergents that could interfere with the ability of fish to absorb oxygen. Despite the intent to avoid spills of lubricants, fuels and other materials, there is a slight possibility that incidental spills would occur. The degree of impact would depend on the volume of retardant or foam released, the size of the water body and the volume of flow in a stream or river. Under any scenario, the park's Hazardous Materials Spill Response program would be put into effect and overall efforts would be made to minimize or eliminate impacts. Such releases would also require consultation with other agencies with responsibility for water quality protection, including EPA and the Washington Department of Ecology. Sedimentation and other water quality impacts would be minimal under this Alternative, since the intent would be to suppress most fires before they burned much area.

Work near water would employ the following mitigation strategies (MIST techniques), BMPs and mitigation strategies to minimize or eliminate impacts to water quality:

- establishing spike camps at least 200 feet from water sources;
- disposing of human waste either by removing it entirely from the site (preferred) or via a 6- 8 inch deep dispersed "cat- hole:"
- capturing and transporting fire camp gray water to acceptable dump sites;
- using biodegradable soap and containing wastewater associated with its use;
- removal of all garbage, including food scraps regularly;
- rehabilitation of fire lines, including implementing erosion control measures that decrease sedimentation;
- using mulching or check dams, as appropriate, to prevent or minimize sedimentation;
- not altering water courses to fight fire;
- prohibiting the use of chemical retardant, foam and gasoline (without secondary containment) near water resources and avoiding the use of retardant and foam elsewhere;
- dipping from only from approved water sources under established conditions (regarding water depth, sensitive resources and method);
- avoiding fire line construction on steep hillsides above park waters.

Hazard Fuel Reduction (Debris Burning and Manual/Mechanical Treatment): There would be no water quality impacts as a result of limited Hazard Fuel Reduction under this Alternative.

Alternative 2 Water Quality Impacts

Under this Alternative, impacts related to wildland fire suppression would be similar to those in Alternative 1. The primary difference would be related to the increased need for mop- up of larger fire areas related to the implementation of Wildland Fire Use as described below. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park water quality.

Wildland Fire Use: This strategy would result in a minor to moderate increase (over Alternative 1) in the extent of park landscape that would be burned, depending on weather conditions, fuel moisture and other factors related to the incidence of lightning strikes and their potential to grow or go out. As a result, this Alternative would also result in an increase in the number of acres that would be subjected to wildland fire suppression activities. Therefore, there would be minor to moderate impacts to area water quality as a result of both wildland fire suppression activities and Wildland Fire Use. The range and type of impacts would be the same as those described above under *Ecological Impacts* and *Fire Suppression* in Alternative 1. On steep

or erosion prone slopes vegetation loss could lead to an increased potential for localized soil erosion and therefore localized impacts to water quality.

Alternative 3 Water Quality Impacts
This Alternative would have the same Fire Suppression impacts as Alternative 1 and the same Wildland Fire Use Impacts as Alternative 2. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park water resources.

Prescribed Fire: Adding Prescribed Fire to the Fire Suppression and Wildland Fire Use strategies would likely result in a negligible additive effect of increasing the area where park fires would occur over time. In any given year, however, dependent on the incidence of naturally ignited wildland fire and the ability to derive predetermined resource benefits from this use would be highly variable, especially given the low natural frequency of fire throughout much of the park. Overall, there would be a negligible increase in the scope and degree of ecological impacts to water quality, as described above under Alternative 1. Prescribed Fires would be managed within a predetermined boundary and would be relatively small. Most would be conducted as either research burns to achieve specific resource objectives or as actions to increase defensible space around developed areas with sensitive administrative or cultural resources. If streams or rivers were used as natural barriers to fire movement, there would be negligible to minor localized impacts on water quality, resulting primarily from the potential to remove vegetation by fire along short stretches of these areas. There would likely be a slight to moderate additional, albeit infrequent, use of chemical fire retardant and foam upon fire escape or suppression activities when fires went out of prescription. Other uses of foam would be to prevent damage to sensitive cultural resources. As mentioned above, the use of these would be avoided near park waters. As required by NPS policy, additional environmental analysis would be completed upon the proposed use of Prescribed Fire in the park. Mitigation strategies identified in Alternative 1 would also be used in this Alternative to minimize or eliminate water quality impacts that might result from prescribed fire implementation.

Alternative 4 Water Quality Impacts
This Alternative would have the same Fire Suppression impacts as Alternative 1 and the same Wildland Fire use impacts to water quality as Alternative 2. As in Alternative 1, the same mitigation measures would be used to minimize or eliminate impacts to water quality.

Hazard Fuel Reduction (debris burning and Manual/Mechanical treatment): Under this Alternative, there would be no or negligible impacts on water quality as a result of these activities. No work would be done near water and there would be very limited possibilities to increase soil erosion in developed areas.

Alternative 5 Water Quality Impacts
This Alternative would result in the same Fire Suppression impacts as Alternative 1, the same Wildland Fire impacts as Alternative 2, the same Prescribed Fire impacts as Alternative 3, and the same Hazard Fuel Reduction impacts as Alternative 4.

Summary/Cumulative Impacts: There would continue to be negligible to minor impacts associated with fire suppression activities, including from chemicals used in fire suppression near developed areas and structures. With the increase in burned area that would likely result under wildland fire use (Alternatives 2-5) or prescribed fire (Alternatives 3 and 5), there would be an increase in the speed of runoff and therefore a potential for minor to moderate water quality impacts from erosion as well as from impacts similar to those associated with fire suppression activities. The above- described range of potential impacts (Alternatives 2-5) would not result in impairment to water quality or the reasons it has been protected in Mount Rainier National Park.

Water Quantity
Alternative 1 Water Quantity Impacts

Depending on the plant community affected, the removal of vegetation would result in negligible to moderate changes in the uptake of water by vegetation. Loss of vegetation would result in higher quantities of runoff in the short- term followed by a gradual return to existing conditions with mature vegetation. This would be most likely to occur under Alternative 1, with its higher likelihood of catastrophic fire due to ongoing fire suppression. There would be minor to moderate short- term localized effects on water quantity under this Alternative as bucket loads of water were taken from approved deep lakes and ponds within the park to enhance firefighting efforts. This would result in short- term loss of some water from these areas. Such use would not be approved if it would result in measurable differences in lake surface elevations or downstream river quantity. Water could also be pumped from rivers or ponds. The amount of water used under this Alternative would be relatively small since the intent of this Alternative would be to suppress all fires as soon as they started or were located. This would result primarily in the need to suppress small fires, although dependent on fuel moisture regimes, season, short or long- term weather patterns and other factors, fire spread could be faster. Suppression of larger fires would require greater quantities of water. When larger quantities of water were required, use would occur over a greater number of potential sources, including in some cases from outside the park. There would be no effect on water quantity as a result of Hazard Fuel Reduction, since minimal hazard fuel reduction would be conducted near water bodies, including streams, rivers or their banks.

Alternative 2 Water Quantity Impacts
This Alternative could result in a slight increase in use of park waters for Fire Suppression, however, the intent would be to enable naturally occurring wildland fires to burn under conditions that would result in minimal need for firefighting. The slight increase in use of park waters would result primarily from the need to control escaped wildland fires or wildland fires that failed under one of the criteria on the Decision Criteria Checklist or Wildland Fire Situation Analysis (WFSA) to meet one of the conditions for Wildland Fire Use. Burns over large areas could result in short- term changes to the hydrologic complexity of part or all of a watershed or watersheds. A reduction in vegetation would cause a subsequent reduction in evapotranspiration, and water flows could increase, resulting in downstream flooding impacts. Unless the entire watershed (or a greater area) was burned, it is likely that such flooding would be indistinguishable from overall annual hydrologic variation related to climate variables, including temperature and precipitation flux. Overall this Alternative would continue to result in minor to moderate short- term localized effects on water quantity, similar to Alternative 1 or 4.

Alternative 3 Water Quantity Impacts
This Alternative would result in similar impacts to water quantity as in Alternative 2. Again, although the intent of Prescribed Fire use would be to avoid the need to use park waters for firefighting efforts, there would continue to be a potential need for appropriate suppression of fires that went out of prescription due to unanticipated weather conditions, inadequate resources to monitor the fire, and or any other go- no go criteria that would enable the fire to continue to burn under the established conditions.

Alternative 4 Water Quantity Impacts
Impacts to water quantity under this Alternative would be the same as Alternative 2. There would be no additional impacts to water quantity as a result of the implementation of a more comprehensive Hazard Fuel Reduction program.

Alternative 5 Water Quantity Impacts
This Alternative would result in the same Fire Suppression impacts as Alternative 1, the same Wildland Fire Use impacts as Alternative 2, the same Prescribed Fire impacts as Alternative 3 and the same Hazard Fuel Reduction impacts as Alternative 2 or 4.

Summary/Cumulative Impacts: Wildland Fire Suppression (Alternatives 1- 5) would result in negligible to moderate effects on water quantity, primarily as a result of the removal of water for firefighting and the removal of vegetation following fire. There would be no effect on water quantity from Hazard Fuel Reduction (Alternatives 1, 4 and 5), either from debris burning or manual/mechanical treatment. Impacts

associated with Wildland Fire Use (Alternatives 2- 5) and Prescribed Fire (Alternatives 3 and 5) would be similar to those associated with Wildland Fire Suppression, including the use of water for firefighting and the slight or widespread effects associated with the removal of vegetative cover. There would be no long-term cumulative impacts on water quantity. The above- described range of potential impacts (Alternatives 2- 5) would not result in impairment to water quantity or the reasons it has been protected in Mount Rainier National Park.

Wetlands

Alternatives 1-5 Wetlands Impacts

The majority of the areas that constitute wetlands in Mount Rainier National Park are too wet to carry a continuous fire front that could result in adverse or beneficial effects to wetland plant communities. During drought conditions that could precipitate impacts to these environments, however, the park would likely be in a fire suppression management strategy. Wetlands, however (like other park plant communities) have developed under the park's natural fire regime. Fire can benefit the long- term presence of wetlands by maintaining open water systems, delaying succession, increasing nutrient cycling, etc. Fires may actually burn across the top of standing water if the fuels are appropriate. Some sedge meadow communities within the park may burn during moderate fires. No fire line construction would be permitted in wetlands. As a result, there would be no or negligible impacts to wetlands under Alternative 1. Impacts to wetlands under Alternatives 2- 5 would be similar to Alternative 1. Overall, however, wetlands could be used as naturally occurring fire breaks during Wildland Fire Use (Alternatives 2- 4), Prescribed Fire Use (Alternative 3) or both (Alternative 5). Under use of these management strategies park wetlands would be only minimally affected by fire, having a natural ability to withstand fire due to high fuel moisture levels and (very often) standing water. The use of Hazard Fuel Reduction (Alternatives 1, 4 and 5) would not result in any impacts to wetlands.

Summary/Cumulative Impacts: Continued use of fire suppression and its alteration of the park's natural fire regime as in Alternative 1, could result in decreasing the persistence of wetlands by minimizing disturbance by fire. This would result in an alteration of wetland successional processes, with more wetlands reaching classic successional climax communities over time. For the same reason, lack of natural disturbance by fire could also alter the diversity of wetland types. The above- described range of potential impacts (Alternatives 2- 5) would not result in impairment of wetlands or the reasons they have been protected in Mount Rainier National Park.

Floodplains

Alternatives 1-5 Floodplains Impacts

Although none of the Alternatives described herein proposes occupancy or modifications to floodplains as described under Executive Order 11988, each has the potential to affect downstream flooding processes, albeit in a way that would likely be indistinguishable from the background flooding that occurs naturally with rain on snow events, spring snowmelt or summer glacial melt (afternoon high flows on rivers of glacial origin). Nonetheless, wildland fires, as described above, may result in short- term minor to moderate downstream flooding impacts related to vegetation removal over part or all of a watershed or watersheds. Since there is a potential for wildland fire to occur under each Alternative, some downstream flooding would likely occur. Such flooding would likely be negligible to minor under Alternative 1 since the intent is to put out fires as soon as they are detected. It would be negligible to moderate under Alternatives 2- 5, where either Wildland Fire Use (Alternatives 2- 4) or Prescribed Fire (Alternative 2) or both (Alternative 5) is proposed. The use of Hazard Fuel Reduction (Alternatives 1, 4 and 5) would not result in any impacts to floodplains.

Summary/Cumulative Impacts: Cumulative Impacts would be the same as described above. The above described range of potential impacts (Alternatives 1- 5) would not impair park floodplains or the values for which these have been protected in Mount Rainier National Park.

VEGETATION

Ecological Effects of Fire on Vegetation: Park ecosystems evolved in response to periodic fire and other disturbance events. As a result, individual species that persist as part of these ecosystems either benefit from fire or are tolerant of it over the long- term, despite possible short- term loss of some individuals and habitat. Elapsed time since the last major disturbance is one of the factors which determines the stage of vegetation succession. Fire is among an array of disturbances that may result in significant short or long- term changes to vegetation cover in both the forest and subalpine environments. Other disturbances to vegetation include snow and rock avalanches, volcanic eruptions, mudflows, floods and wind (Franklin *et al.* 1988). As mentioned earlier, wildfire has been the most important forest- disturbance agent near Mount Rainier and has affected all but a small fraction of the forest area during the last 1,000 years (Franklin *et al.* 1988).

Fires are primarily responsible for forest succession, the maintenance of landscape mosaics, stand age and structural diversity and species diversity. Fires often cause major changes in vegetation, including plant community composition (species diversity and arrangement). Dependent on the locale, fires can result in reoccurrence of the same species or a complete change in forest species dominance. Fires can also result in a variety of vegetation impacts, including, as mentioned, short or long- term localized or profound changes to vegetative cover. Depending on their timing, location, severity and extent, fires can result in complete removal of vegetative cover, in forest stand replacement, or simply in removal of fine fuels and forest duff. Fires may increase plant vigor or damage or kill plants. Fires can change the localized or long- term dominance of early and late seral species.

High fire severity can remove soil organic matter, lower the soil pH and nitrogen content, kill rhizomes and mycorrhiza, cause soil to repel water, and result in short and long- term changes to vegetation communities. Fires may result in increased or decreased soil fertility and water holding capacity. Where fires have resulted in water repellant soils that have lost structure, vegetation establishment after fire may be poor. Where fire severity is high, a fairly extreme environment for plant germination and growth results. These severe impacts, however, are often limited in distribution within the perimeter of a fire. Even high intensity fires may result in a beneficial impact to vegetation. Seed banks often remain viable and are released as a result of the increased flush of nutrients, light and water. Fires can also result in beneficial impacts related to park management, including a decreased need for scenic vista management, pending natural fire occurrence or prescribed fire use.

In the park, periodic fires are correlated with the mosaic of subalpine fir forests, subalpine meadows and tree clumps and the maintenance of specific plant communities, including whitebark pine. In most cases, however, the degree to which fire has influenced these communities is currently unknown and some communities, such as subalpine meadows may be influenced more by snow cover than fire (see earlier reference under *Fire History*).

Alternative 1 Vegetation Impacts

Fire Suppression: With all fires immediately suppressed under this Alternative, there would be limited short term impacts to vegetation, although long- term impacts would be extensive. Exceptions to immediate and direct fire suppression would be made on a case- by- case basis for reasons of inaccessibility, life/safety concerns for firefighters, or a lack of availability of suitable resources, personnel or equipment. In fact, the suppression response would vary depending on the location, timing, and extent of the fire. The indirect effects of fire suppression would include loss of diversity in vegetation communities over time as the lack of fire reduces the role of fire as a disturbance agent. With continued fire suppression of all fires in the park, natural vegetation mosaics caused by lightning fires would continue to change until they were indistinguishable from surrounding areas. With an extensive lack of fire disturbance continued indefinitely, forest stands would reach late successional stages and structural, biological and aesthetic diversity would diminish. The effects of fire suppression would be greatest, in the short- run, on the east side of the park, where fire return intervals may be 200 years or less. Species dependent on openings in the forest for regeneration, such as Douglas- fir would likely decline over time, while species, such as western hemlock, which thrives in shade, would increase. On the west side of the park where fire return intervals are 465 years or more, there would be little consequent noticeable change in vegetation. In the mountain hemlock and

subalpine fir zone, the exclusion of fire could eventually reduce the predominance of subalpine meadows; however, these are primarily maintained by snow, rather than fire. Gradual alteration of local ecosystems in the absence of fire could lead to localized disappearance of some species. Without fire, other disturbance agents, such as avalanches and debris flows would continue to result in some early successional landscapes, but these would cover more limited areas. In other locations, there could be a loss of some early successional species and some resultant increase in homogeneity of wildlife habitat.

The effects of fire suppression activities, including fire line construction, with an increase in disturbed area, would include an increased potential for non- native species invasion. There would be an increased potential in fire suppression activities for exotics to invade as a result of poor tool cleaning or the importation of equipment contaminated with exotic seeds. The potential for non- native species invasions, however, would be dependent on the source area for the non- natives as well as other factors. In the park, most non- native species are confined to developed areas, particularly roadsides. Burned areas with exposed mineral soil would provide a nutrient rich seedbed conducive to invasion by pioneer species, including non-natives. It could also result in release of native species long dormant in the seedbank. Overall, the long- term effects of fires include increased potential for blow- downs, increased effects of wind and water erosion on vegetation patterns, changes in vegetation re- establishment, etc.

Constructed fire lines would have an increased potential for invasion of exotic species and could result in loss of long- lived subalpine plants, with a consequent need for additional restoration.

The following MIST and best management practices, not mentioned above, to minimize or eliminate impacts to vegetation include:

- Ensuring that firefighting equipment or supplies are not contaminated with noxious weed seeds (consider steam- cleaning equipment, as appropriate prior to transport into park or use in sensitive areas).
- According to the Mount Rainier Restoration Handbook (1990), the following actions would be used to limit the effects of fire lines on vegetation. Constructed fire lines would be rehabilitated when the fire is out and the fireline is no longer needed for control actions. Rehabilitation plans would be discussed with park resource staff prior to implementation. If necessary, fire lines would be filled to grade to prevent channeling of water and attendant erosion. Upon filling to grade, restoration would include replanting with salvaged vegetation or covering with duff and excelsior, as needed. Scattering brush, dead limbs or rocks randomly along the trail could also help to impede water erosion and to camouflage the lines.
- Dependent on the type of terrain, the following minimum standards for fire line rehabilitation from the Wildland Fire Resource Advisor's Task Book (NPS 1992) would be used:

  <u>Flat or Gentle Sloping Terrain (0- 14 degree slopes) and Moderately Sloping Terrain (15- 29 degree slopes)</u>

  - Recontour line to match surrounding terrain by pulling soil, litter, duff and rocks back over line
  - Remove/recontour trenches
  - Scatter piles of slash near and over line
  - Flush cut stumps (aesthetic)

  <u>Steeply Sloping Terrain (>29 degree slopes)</u>

  - Rake along contour to create small, shallow trenches across fall line
  - Recontour line as above to match surrounding terrain by pulling 2- 4 inches of litter and duff back over line
  - Remove/recontour trenches
  - Place rock (with previously exposed lichen side up) and logs randomly on fall line to intercept adjacent runoff
  - Scatter piles of adjacent slash near and over line

- Flush cut stumps (aesthetic)

- Trees to be felled and left on site would not be bucked or limbed, except in developed areas or along designated trails.
- Reseeding, which has largely proven unsuccessful, unless native species are used, would not be undertaken.
- When possible, construction of fire lines would not be undertaken in sensitive subalpine areas.
- Fire camps and other operations assemblages would take place in developed areas or areas where clear indications of recent human disturbance (bare ground) are present.
- Fire lines of the minimum possible depth and width would be used.
- Care would be taken to select suppression tactics, procedures, tools and equipment with the least possible impact to the environment.
- Equipment used in firefighting would be cleaned as appropriate prior to use in park firefighting efforts.
- Mulches or other rehabilitation treatments, including straw bales would come only from sources approved by the park plant ecologist.

Use of the above strategies, MIST and other best management practices described elsewhere in this plan would result in negligible to moderate impacts on park vegetation resources under Alternative 1, depending on the location, timing, extent and severity of the fire and fire suppression efforts.

Hazard Fuel Reduction (Limited Debris Burning): This activity would have negligible effects on vegetation. These negligible effects would be attributed to the indirect effect of burning a small portion of the overhanging limbs trimmed around park facilities and structures and other dead and downed materials collected in developed areas.

Hazard Fuel Reduction (Limited Manual/Mechanical Treatment): This activity would have negligible effects on park vegetation resources, as individual limbs, trees and shrubs were removed to diminish fire hazards in non- wilderness developed areas. The areas treated under this activity would already be heavily managed landscapes near park visitor, administrative and maintenance facilities in developed areas and where needed in outlying areas to minimize impacts to utilities, such as water collection and distribution systems.

Alternative 2 Vegetation Impacts

Under this Alternative, vegetation impacts related to Fire Suppression would be the same as Alternative 1. With the use of wildland fire, however, there could be fewer impacts from constructed fire lines, depending on the likelihood of most naturally occurring wildland fires to remain small and to naturally extinguish themselves.

Wildland Fire Use: Under this Alternative, dependent on natural ignitions in areas of the park that would result in resource benefits, some lightning strikes would be managed under a Wildland Fire Use strategy. Over time, use of this strategy would result in the return of a natural fire regime to the park landscape. As a result, vegetative diversity now present, historically maintained by fire, would continue to carry naturally occurring wildland fire. Alterations in the park's fire regime due to Fire Suppression would diminish and result in localized and potentially widespread changes in the vegetation. These changes would include many of the same impacts discussed above under *Ecological Effects of Fire on Vegetation* including:

- changes in the ability of soil as a medium for plant growth;
- some changes in wetland/riparian vegetation communities used as natural wildland fire or fire suppression buffers;
- an increased potential for exotic species invasion as a result of fire suppression activities;
- a potential increase in the number of hazard trees treated in roadside or other developed areas where fire occurred; and

- a potential increase in blow- downs due to changes in air circulation patterns during storms as a result of tree removal by fire, etc.

Under this Alternative, most fires would remain relatively small, although (depending on a number of factors including local and regional weather conditions, fuel moisture, etc.) some fires would become large and stand- replacing, resulting in long- term changes to vegetation in some areas of the park. Less intense, creeping ground fires are also possible. During some years there would be a fair number of fires used for resource benefits, in other years there might be only a few lightning strikes that burned out quickly. Larger or more intense fires would result in greater effects.

Naturally occurring wildland fire, including high intensity fires, would contribute to maintaining the mosaic of vegetation community types in the park. Fire tolerant plant communities could be benefited by fire, with fires resulting in natural restoration of the diversity or persistence of some species. There would be an increase in habitat diversity for wildlife and increased wildlife use of some areas, resulting in better dispersal of seeds by wildlife, an increase in the number of snags, and other factors that affect future plant distribution. Some unknown effects of fire in high elevation meadows could occur. This could present additional opportunities for research on these plant communities and their relationship to fire as a natural disturbance. Subalpine forest/meadow communities and whitebark pine communities would benefit from disturbance by fire. Under this Alternative, some fires would continue to be suppressed, including all human- caused fires, some fires that began under conditions that would not result in resource benefits, and those in sensitive or endangered species habitats that could not withstand additional disturbance by fire. The use of naturally occurring wildland fire along the park boundary, under the right conditions, could result in an increased ability to control future fires from burning onto adjacent lands unable or unwilling to accept fire management. Overall, the impacts of Wildland Fire Use on vegetation would range from negligible to major and would be reduced by appropriate MIST, BMPs and other mitigation strategies as described above and herein.

Alternative 3 Vegetation Impacts

This Alternative would result in Fire Suppression effects similar to Alternative 1 and Wildland Fire Use effects similar to Alternative 2.

Prescribed Fire: Use of Prescribed Fire under this Alternative would result in a variety of ecological impacts related to fire on park vegetation resources, including those described above in Alternatives 1 and 2 with respect to Fire Suppression and Wildland Fire use. Although no specific Prescribed Fire plans have yet been developed, the use of fire under this Alternative would be expected to remain small; similar to the wide variation in fire size over the park's known fire history. As envisioned above, Prescribed Fires could be used to:

- maintain scenic vistas;
- maintain fire dependent plant communities;
- restore plant communities;
- increase vegetation diversity (mosaics);
- maintain some boundary areas (where cross- boundary fire is unacceptable);
- manage sensitive resource areas that would need to have cooler fires with lower intensities to prevent damage to the resource at risk;
- restore cultural or ethnographic landscapes; and
- reduce hazard fuel accumulations near developed areas, etc.

As a result, Prescribed Fire use would result in a wide array of vegetation impacts similar to those described above in Alternatives 1 and 2. While in general, Prescribed Fires would burn at lower overall intensities, they would, in fact, have varying intensities, dependent on the vegetation type and its fuel type characteristics, including time since the last disturbance. Although the effects of the use of Prescribed Fire could be cumulative (in addition to the effects from Wildland Fire Use), it is more likely that the use of Prescribed

Fire would substitute for Wildland Fire Use or vice versa. As a result, the effects of this Alternative would be very similar to those described above under Alternative 2: Wildland Fire Use.
Overall, with the addition of prescribed fire, these impacts would be negligible to moderate under most scenarios (small fires), but could become moderate to major, depending on fire location, timing, extent and severity. As mentioned, the actual impacts of Prescribed Fire would be analyzed in an additional environmental document upon development of burn plans.

Alternative 4 Vegetation Impacts
Impacts related to Fire Suppression would be the same as Alternative 1 and impacts related to Wildland Fire Use would be the same as Alternative 2.

Hazard Fuel Reduction (Debris Burning): Although more extensive use of debris burning could be made under this Alternative than as described under Alternative 1, this activity would continue to have negligible effects on vegetation, since it would be conducted in very limited areas (such as the Kautz Creek maintenance area and the Ohanapecosh Wastewater Treatment Plant area). These negligible effects would be attributed to the indirect effect of burning a small portion of the overhanging limbs trimmed around park facilities and structures and other dead and downed materials collected in developed areas.

Hazard Fuel Reduction (Manual/Mechanical Treatment): Unlike Alternative 1, under this Alternative, there would be systematic treatment of hazardous accumulations of fuels in developed areas throughout the park. As mentioned above, this could include up to 20 percent of the park's non- wilderness developed areas per year – resulting in treatment on a 5 year rotating schedule parkwide. Again, as mentioned, such treatment would not be uniform. Some areas would receive more thorough treatment than other areas. This would result in a more extensive program of individual limb, tree and shrub removal to diminish fire hazards in non- wilderness developed areas. The areas treated under this activity would already be heavily managed landscapes near park visitor, administrative and maintenance facilities in developed areas and where needed in outlying areas to minimize impacts to utilities, such as water collection and distribution systems. Treatment would include cutting of vegetation, including removal of undesirable vegetation near buildings and structures, resulting in the unnatural appearance of vegetation in developed areas. As in Alternative 1, it would also include the current program of roadside mowing to reduce the potential for vehicle- caused fires along park roads. Treatment of hazard fuels could include some other roadside vegetation clearing of overhanging limbs and some clearance of scenic vistas where prescribed fire treatments might also be undertaken. Under very specific conditions (see Wilderness impacts analysis), some fuels reduction in wilderness could be undertaken to remove overhanging vegetation or limited vegetation surrounding historic structures in wilderness or other sensitive resource areas not able to withstand fire. To the degree possible, a variety of methods to dispose of hazard fuels would be used. These methods would include dispersing cut vegetation immediately back into forested areas surrounding developed areas (a common practice along roadsides); broadcast chipping of cut vegetation through the area treated; etc. To limit air quality impacts, pile burning (as described above would be used as a last resort) and only under specified controlled conditions. To limit vegetation impacts, chips would be broadcast, resulting in a discontinuous thin layer to minimize impacts on soil nitrogen content (chip decomposition consumes large amounts of nitrogen).

Alternative 5 Vegetation Impacts
As with other alternative effects analyses in this Environmental Assessment, this Alternative would result in the greatest degree of management flexibility in the appropriate application of wildland fire management strategies over the park landscape. As a result, this Alternative would have the potential to elicit the best integration or combination of strategies in a way that would cause the least possible adverse effects to park resources. In general, however, this Alternative would have Fire Suppression impacts similar to Alternative 1, Wildland Fire Use impacts similar to Alternative 2, Prescribed Fire impacts similar to Alternative 3 and Hazard Fuel Reduction impacts similar to Alternative 4.

Summary/Cumulative Impacts: Alternative 1 would result in minor short- term and major long- term cumulative impacts to vegetation, affecting vegetation diversity, distribution and persistence. Alternative 1 would also have the potential (over time) to result in impairment to vegetation as a result of continued alteration of the park's natural fire regime. Because park ecosystems evolved in response to periodic fire, Wildland Fire Use in Alternatives 2- 5 and Prescribed Fire in Alternatives 3 and 5 would result in minor to moderate short- term adverse impacts, causing the loss of some individuals and portions of plant communities. These alternatives would also result in long- term cumulative beneficial impacts by beginning to restore the natural role of fire to the park landscape. These alternatives would also contribute to a more natural array of vegetation types distributed throughout the park landscape. The above described range of potential impacts (Alternatives 2- 5) would not impair park vegetation or the values for which this resource has been protected in Mount Rainier National Park.

WILDLIFE

Ecological Effects of Fire on Terrestrial Wildlife: Park ecosystems evolved in response to periodic fire and other disturbance events. As a result, individual species that persist as part of these ecosystems either benefit from fire or are tolerant of it over the long- term, despite possible short- term loss of some individuals and habitat. As such, wildlife populations that currently occur in the park existed here in the presence of fire under historic fire regime conditions. There would be a range of both adverse and beneficial impacts to wildlife, depending on the species affected, and the season, timing, intensity of the fire and the rate of fire spread. These impacts would include alteration of habitat, species composition and population levels.

The park's fire history shows the largest fire within the park to have been a road clearing fire that escaped and burned 11,000 acres in the 1930s. Excepting that, large fires have been in the range of 2,500 to 11,000 acres and most fires have been on the order of 1,000 acres or less. Finally, the most frequent fires are much smaller, on the order of 1- 5 acres or less. Therefore, it is reasonable to assume that unless regional weather patterns precipitated extremely large catastrophic fires (that under any scenario would likely be difficult to contain or control), that the fire management strategies employed in this plan, including Fire Suppression, Wildland Fire Use, and Prescribed Fire, would primarily result in a large number of fires less than 5 acres, some fires up to 1,000 acres, and a few fires between 1,000 and 5,000 acres. The actual size and number of fires would depend on prevailing weather patterns, the location of lightning strikes, and the extent of fire spread before naturally extinguished or suppressed. With approximately 190,000 acres of forested and subalpine habitat in the park, such fires would have little consequence on long- term impacts to wildlife species, and if spread over the park in a pattern similar to its current mosaic of forest stand age classes (Forest Age Map) would result in overall beneficial impacts to species. Increased soil temperatures, smoke, erosion, and changes in vegetation also affect wildlife. While some loss or displacement of individual animals would inevitably occur in burned areas there would be long- term benefits to some populations as a result of restoration of fire- created habitat diversity. Wildlife would have a wide variety of reactions to fire, including burrowing, fleeing and flying. Some species, such as terrestrial amphibians, reptiles, insects and small mammals may survive fast- moving, low intensity fires by burrowing or fleeing, while some larger animals would not be able to move out of the fire path in time, becoming disoriented by the fire.

Riparian corridors and wetlands may act as refugia for some animals during fires. While soil surface temperatures remain high during fire, the soil below the surface (as few as 4 inches deep) may insulate against temperatures as high as 1000 degrees F (Lawrence 1966 in Barro and Conard 1991). Studies of pocket gophers in the Sierra Nevada, however, have determined that vapor pressure in burrows appears to be a better indication of survival of small mammals than temperature. Fires often result in a temporary increase in insect- feeding birds. Other species that may increase following fire include scavenger/predators such as ravens. Overall, forage species are often enhanced by an increase in nutrients, resulting in similar increases or benefits to populations dependent on these species. With the nutrient rich post- fire flush of herbaceous vegetation increasing browse for deer and other animals, prey- stalking opportunities also would increase. Such populations often increase where suitable habitat has burned. That habitat may be enhanced or expanded. The minor to major effects of fire on wildlife may be short or long- term depending on vegetation recovery, fire severity and other factors.

Ecological Effects of Fire on Aquatic Wildlife: Direct effects of natural fire (or unplanned human- caused ignitions) on park waters would include changes in water chemistry, soils, water temperature and vegetation associated with water resources. Indirect effects could include changes in fish and amphibian species composition, habitat dynamics, accumulation of woody debris, water yield, hydrologic processes, erosion patterns, and nutrient cycling. These changes may result in either beneficial or adverse impacts, depending on factors related to fire severity, season, location, vegetation type, and magnitude of burns. Increased sediment yield and water temperatures would tend to be short- lived, unless a fire was of extreme severity. Increases in runoff and nutrient flux would be expected to continue for several years (as many as ten years), particularly after large fires. Although a natural process, large or severe fires could create negative impacts on fisheries if they caused changes in water quality at a time when the fishery was most vulnerable.

For strategies that would be used to minimize or eliminate impacts to aquatic species, refer to the sections that follow on *Rare, Threatened and Endangered Species and Habitats* and *Impacts to Rare, Threatened or Endangered Fish.*

Alternative 1 Wildlife Impacts

Fire Suppression: In addition to the ecological impacts of fire on wildlife as described above, the noise and activity associated with wildland fire fighting would result in a variety of impacts to wildlife that would be similar to the impacts associated with construction projects or visitor use in developed areas. Since the incidence of both lightning and human- caused fires is low, these impacts would continue to be minor under this Alternative. Periodically, there would be more moderate impacts associated with wildland firefighting especially when extreme weather conditions that resulted in a great deal of fire spread before fire suppression could be accomplished. The mobilization and dispersal of a small or large number of firefighters would result in the use of vehicles, staging and other actions that in combination would result in a decrease in wildlife presence in the vicinity of the firefighting effort. These activities would often take place throughout the day and night, resulting in disturbance during normally quiet periods. The use of helicopters for transport of personnel and firefighting would result in additional disturbance of animals. The short- term noise and activity would likely cause alarm, confusion and other behavioral responses in large and small wildlife species. Ongoing helicopter reconnaissance and monitoring related to fire behavior analysis and suppression could result in the same impacts repeated over the duration of the fire. Once the fire had been suppressed, the above short- term minor to moderate impacts would cease and wildlife behavior would return to pre- suppression conditions. Although there would be no long- term effects of fire suppression related activities (noise and disturbance) on wildlife (dependent on the timing, location, duration and extent of the fire) it could result in short- term impacts on breeding, gestation or other processes associated with bearing young or finding food. These impacts could result from stress.

Factors that would minimize or avoid long- term effects on wildlife as a result of fire suppression activities would include:

- use of developed areas or areas extensively disturbed by human impacts for staging fire suppression activities
- limiting the types of activities, such as helicopter operations (See Appendix 1) that would be performed at dawn, dusk or night as appropriate to minimize impacts to threatened and endangered species;
- relying on existing trails to the extent possible to access fires
- relying to the extent possible on water sources outside the park for firefighting efforts
- minimizing the use of fire retardant or foams in suppression efforts
- ensuring that firefighting equipment was in good condition and using best management practices to ensure that spills of lubricants, fuels or other chemicals does not occur
- using other minimum impact suppression and mop- up techniques (as described in Appendix 1); etc.

Hazard Fuel Reduction (Limited Debris Burning and Manual/Mechanical Treatment): There would be only negligible to minor impacts to wildlife associated with the continued implementation of the park's limited hazard fuel reduction (debris burning and Manual/Mechanical treatment) program. These impacts would primarily be related to short- term noise and activity, smoke production, and increased human presence along the edges of developed areas and at the designated areas, where such treatment would take place. Other impacts would include the reduction in song bird foraging area and cover.

Alternative 2 Wildlife Impacts

Under this Alternative, impacts related to wildland fire suppression would be similar to those in Alternative 1. The primary difference would be related to the increased need for mop- up of larger fire areas related to the implementation of Wildland Fire Use as described below, however if the fire stays within prescription and within the maximum management area (MMA) mop- up would be similar to impacts noted under wildland suppression. As described above, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park wildlife.

Wildland Fire Use: In addition to the broad range of adverse and beneficial ecological impacts on wildlife described above, using this fire management strategy would result in a minor to moderate long- term ecological benefit to wildlife. This would primarily be as a result of the restoration of a natural fire regime to an ecosystem that developed in the presence of natural wildland fire. Depending on the location, severity and extent of the Wildland Fire Use, there would be minor to moderate adverse effects on wildlife habitat and wildlife presence. Except in the unlikely event of extremely large ecosystem- wide fires that burned over a major portion of the park, including over more than one watershed, wildlife impacts would be minor to moderate. Although fire, smoke inhalation or stress would kill some animals, other animals would escape to unburned refuges (such as riparian or other wetland areas) and would repopulate the burned area within a short time. Immediately after the burn, there would likely be increases in some bird species, some browsers and some predators. Some species would naturally take longer to recover pre- fire population sizes. In the long- term, though, most would benefit, over the long- term, from the effects of fire on returning some areas to an early successional stage, where low- growing shoots and herbaceous vegetation in clearings were available. The utility of these areas adjacent to unburned or lightly burned late successional areas would increase localized wildlife diversity and presence.

Alternative 3 Wildlife Impacts

This Alternative would have the same Fire Suppression impacts as Alternative 1 and the same Wildland Fire Use Impacts as Alternative 2. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park wildlife.

Prescribed Fire: The effects of this management strategy on wildlife would be similar to Wildland Fire Use as described in Alternative 2 and would also include the generalized ecological effects of fire on wildlife as described above. The actual effects of Prescribed Fire on wildlife would depend on the location, timing, extent and severity of the Prescribed Fire use and would be analyzed upon development of a prescribed fire plan in a separate environmental document. Although the effects of the use of Prescribed Fire could be cumulative (in addition to the effects from Wildland Fire Use), it is more likely that the use of Prescribed Fire would substitute for Wildland Fire Use or vice versa. As a result, the effects of this Alternative would be very similar to those described above under Alternative 2: Wildland Fire Use.

Alternative 4 Wildlife Impacts

This Alternative would have the same Fire Suppression impacts as Alternative 1 and the same Wildland Fire Use Impacts as Alternative 2. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park wildlife.

Hazard Fuel Reduction (Debris Burning): Impacts would be similar to, but negligibly more extensive than Alternative 1. With a more comprehensive Hazard Fuel Reduction program in place, additional days of debris burning would necessarily occur. However, these would occur in the same locations as in Alternative

1 and would be limited to park established guidelines for debris burning, including pile size. As a result, there would be similar negligible to minor localized effects on wildlife near the Kautz Creek maintenance area and other designated areas, where a high degree of administrative activity already limits wildlife presence during the primary visitor use season (when most fires would occur).

Hazard Fuel Reduction (Manual/Mechanical Treatment): Under this Alternative, compared to Alternative 1, there would be an increase in the effectiveness of the fuel reduction treatment and an increase in the overall area treated. This would result in potentially minor increase in wildlife disturbance impacts related to using heavy equipment in developed areas, such as along roadsides, to effectively reduce hazardous accumulations of fuels. It would also have a negligible increase in other areas where hand tools, including chain saws might be used. Few other impacts to wildlife would be anticipated under this fire management strategy.

Alternative 5 Wildlife Impacts

This Alternative would result in the same Fire Suppression impacts as Alternative 1, the same Wildland Fire Use impacts as Alternative 2, and the same Prescribed Fire impacts as Alternative 3. It could however result in slightly different Hazard Fuel Reduction impacts than in Alternative 4. That is, a long- term slight beneficial impact could result from a more comprehensive program of hazard fuel reduction in developed areas where sufficient clearance of debris was obtained by potentially reducing or eliminating the need for the limited use of prescribed fire use in these areas. As a result there would be a negligible decrease in the impacts of fire on wildlife than would a broader application of the use of Prescribed Fire in developed areas. The use of selective debris burning of accumulations of fuel collected in developed areas would also have a minor beneficial effect in increasing the ability to control prescribed or wildland fires that affected these areas. As in Alternative 1, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park wildlife.

Summary/Cumulative Impacts: Wildland Fire Suppression under any alternative would result in short- term minor to moderate noise and activity that would decrease the presence of wildlife in the vicinity of the firefighting effort. Other short- term impacts would potentially include effects on breeding, gestation, or other processes associated with bearing young or finding food. Complete suppression of fires under Alternative 1 would have the potential to result in changes in vegetation composition over time and would consequently have minor to moderate effects on wildlife species composition and distribution. Alternatives 2- 5, which call for wildland fire use or prescribed fire would restore the role of fire. Despite some short- term loss of individuals and habitat, over the long- term most species would benefit from fire. Short- and long- term effects would depend on the species, the season, timing, intensity and rate of fire spread. Cumulative effects from the action alternatives would result in better forage for ungulate species, and an increase array of mosaic type habitats with a consequent decrease in the potential for catastrophic fire. The above described range of potential impacts (Alternatives 2- 5) would not impair park wildlife or the values for which this resource has been protected in Mount Rainier National Park.

RARE, THREATENED AND ENDANGERED SPECIES AND HABITATS

Ecological Effects of Fire on Rare, Threatened and Endangered Species and Habitats: As described above under general Wildlife Impacts, park ecosystems have evolved in response to periodic fire and other disturbance events. As a result, individual species that persist as part of these ecosystems either benefit from fire or are tolerant of it over the long- term, despite possible short- term loss of some individuals and habitat. Because of widespread habitat loss is the primary factor responsible for the decline of many rare, threatened and endangered species. It is now true that protected areas, such as Mount Rainier National Park constitute some of the last remaining habitat for these species. In the Pacific Northwest, there has been a loss of over hundreds of thousands of acres of old growth and late- successional forests. Losses of other types of habitats (especially level terrain and valley bottoms) where most development in the Puget Sound region has been focussed, have been even greater. Consequently, even naturally occurring fires spread over a wide area, could result in long- term adverse effects on some species due to the absence of similar habitat to disperse to. For example, species dependent on old growth or late- successional forests may not find suitable habitat to disperse to in the event of extremely large catastrophic fires. As discussed above under

Wildlife, the park's fire history, however, shows recent large fires to have been in the range of 2,500 to 11,000 acres, while most moderate fires have been on the order of 1,000 acres or less. Finally, the most frequent fires are much smaller, on the order of 1- 5 acres or less. Therefore, it is reasonable to assume that unless regional weather patterns precipitated extremely large catastrophic fires (that under any scenario would likely be difficult to contain or control), that the fire management strategies employed in this plan, including Fire Suppression, Wildland Fire Use, and Prescribed Fire, would primarily result in a large number of fires less than 5 acres, some fires up to 2,500 acres, and a few fires between 2,500 and 11,000 acres. The actual size and number of fires would depend on prevailing weather patterns, the location of lightning strikes, and the extent of fire spread before naturally extinguished or suppressed. As discussed under *Wildlife*, with approximately 190,000 acres of forested and subalpine habitat in the park, such fires would have little consequence on long- term impacts to endangered species, and if spread over the park in a pattern similar to its current mosaic of forest stand age classes (Forest Age Map) would result in overall beneficial impacts to species. Notwithstanding that, there would likely be, despite park management efforts to prevent them, some mortality of individual species over the long- range implementation of this plan. In addition, during Fire Suppression efforts, there would likely be some disturbance of individuals from associated helicopter reconnaissance and monitoring related to fire behavior analysis and suppression.

To minimize or eliminate these effects, the following strategies would be used under all Alternatives described herein:

- The park would continue to build on its inventory and monitoring program for rare, threatened and endangered species and habitats, including conducting surveys to USFWS protocol as needed to cover future actions proposed by this plan.
- To the extent practicable, Prescribed Fire, under future environmental analysis, would either avoid nesting or spawning seasons or would not be conducted in areas where analysis of rare species and habitat had not been made.
- For naturally occurring Wildland Fire (lightning strikes) and potential future Prescribed Fires, documentation of immediate post- fire threats to rare, threatened and endangered species and habitats and actions to prevent further degradation of these species would occur immediately following fire use or suppression activities.
- To the degree possible, direct fire- related mortality of rare species, including known habitat or activity sites, would be avoided.
- Suppression activities, fire effects monitoring and smoke production would be carefully monitored in the vicinity of known habitat for the decision process with respect to all fires (including suppression and use).
- To the degree possible, construction of fire lines would avoid known rare, threatened or endangered species habitat.
- During future Prescribed Fires, in known rare, threatened or endangered bird habitat post nesting season, cooler burn prescriptions would be used and some degree of hazard fuel removal could be used to limit the potential for crown fires.
- Alternatives that include Hazard Fuel Reduction must have no effect, be not likely to adversely affect or would have beneficial effects or they would not be conducted within known or potential habitat for rare, threatened or endangered species. In other words, noise from heavy equipment or chainsaw use above the ambient level would occur more than ¼ mile away from potential habitat. No nest trees or other specific habitat for rare species would be removed.
- In areas below 4,800 feet, helicopters used in wildland fire suppression efforts would fly ½ mile (about 2,600 feet) above the canopy during the early nesting season (March 1- August 6) for both northern spotted owls and marbled murrelets.
- Helicopters would be staged, to the degree possible, during nesting season fire suppression efforts above the elevation of northern spotted owl (4,800 feet) and marbled murrelet (3,500 feet) nesting habitat (e.g. Fourth Crossing rather than Kautz Creek).

Impacts of Alternatives 1-5 on Rare, Threatened or Endangered Plants

Sensitive plant species listed by the U.S. Fish and Wildlife Service, Washington State Natural Heritage Program, and the Northwest Forest Plan would continue to be at risk of additional natural ecological and human impacts. The gradual alteration of the park and regional ecosystems over the past 100 years has likely been responsible for the decline of some fire dependent, disturbance- associated species. In addition, during fire suppression activities, physical destruction of sensitive species and their habitat could occur. For most species, however, it is unknown what effect fire would have on their persistence. To the extent that knowledge of the locations of these species exists, the park would make protection of their habitat a high priority during fire and therefore would not allow fire lines within or other physical disturbance to that habitat. The park, however, would not (unless specific data showed potential loss of these species) prevent fire from burning through that habitat.

As a result of the implementation of any of the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire as described herein, there would be a range of potential impacts to rare plant species and their habitats, including no effect, not likely to adversely affect and possible beneficial or adverse effects. There would be no effect on rare plant species as a result of Hazard Fuel Reduction, since it would be avoided in areas where rare plant species are located.

Summary/Cumulative Impacts: The above described range of potential impacts (Alternatives 1- 5) would vary widely but would not impair park rare, threatened or endangered plants or the values for which they have been protected in Mount Rainier National Park.

Rare, Threatened and Endangered Wildlife
Impacts of Alternatives 1-5 on Northern Spotted Owls

Fire Suppression use since the park's establishment has likely had a detrimental effect on rare species, since habitat changes as a result of disturbance are often critical to long- term survival of some species. Historically, fire and other disturbance agents have had both adverse and beneficial effects on habitat for all park species over time. For northern spotted owls, some mortality would be expected during catastrophic (stand replacing) wildland fires occurring during the nesting season (March 1 – September 30), with heavy smoke or crown fires. As mentioned, habitat destruction outside the park (as a result of urban development, logging and wildland fire suppression, etc.) has resulted in increasing vulnerability of late successional species, such as northern spotted owls, to stand replacing fire effects. Within the park, however, habitat modifications have been relatively minor and have not had a significant effect on northern spotted owls. With such a long fire return interval (averaging over 400 years), there has not been enough time under human management of the park (100 years) to significantly affect the natural fire regime, especially since effective fire fighting in the west began only in the early 1950s. Although adult owls could escape a fire, adverse effects to individual nestlings and eggs from nest tree damage or destruction and to the nestlings from excessive smoke could result. As a result, suppression activities, fire effects monitoring and smoke production would be carefully monitored in the vicinity of known owl nesting areas. The use of Wildland Fire or Prescribed Fire would involve an analysis of the potential adverse and beneficial ecological effects of fires, as well as its potential effects on individual species such as northern spotted owls. Foraging habitat for northern spotted owls could improve as open areas for voles, mice and other small mammals were created by Wildland Fire Use or Prescribed Fire. As mentioned above, avoidance (to the degree possible) of known activity sites and habitat for northern spotted owls, would mitigate such use.

Under the Alternatives involving Fire Suppression (1- 5) or Wildland Fire Use, as described in this Environmental Assessment, impacts to northern spotted owls could range from no effect to not likely to adversely affect to beneficial or adverse effects, depending on the fire location, severity and extent. As mentioned above, to the extent practicable, Prescribed Fire (under future environmental analysis) would either avoid nesting or spawning seasons. Prescribed Fire would also not be conducted in areas where analysis of rare species and habitat had not been made. As a result, alternatives involving Prescribed Fire (3 and 5) would have either no effect or would be not likely to adversely affect or would beneficially affect northern spotted owls. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Marbled Murrelets
The potential for impacts to marbled murrelets would be the same as those indicated for northern spotted owls in the discussion above. However, it would be less likely that wildland fire would result in beneficial effects to murrelets, since they are not dependent on surrounding habitat quality within the park for food. Rather, stand replacing fires or extensive fire effects in their nesting habitat with the park could result in a more open canopy, thereby reducing its desirability while nesting (April 1 – September 15). In addition to the mitigation measures listed above for northern spotted owls, and, in general, for rare, threatened and endangered species, in potential or documented habitat, air operations would be avoided to the degree possible until two hours after sunrise and curtailed two hours before sunset during fire suppression activities. This would be true especially during the early nesting season (April 1 – August 6).

Under the Alternatives involving Fire Suppression (1- 5) or Wildland Fire Use (2- 5), as described in this Environmental Assessment, impacts to marbled murrelets could range from no effect to not likely to adversely affect to beneficial or adverse effects, depending on the fire location, severity and extent. Prescribed Fire, under future environmental analysis, would either avoid nesting or spawning seasons or would not be conducted in areas where analysis of rare species and habitat had not been made. As a result, alternatives involving Prescribed Fire (3 and 5) would have either no effect or would be not likely to adversely affect or would beneficially affect marbled murrelets. As mentioned above, Alternatives that include Hazard Fuel Reduction would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Bald Eagles
Most park lakes are covered by ice from December through June, although melt is dependent on elevation and winter severity. If nesting bald eagles were located in the park, additional precautions to avoid disturbance would occur between January 1 and August 15 in known nest locations. Wildland Fire Use or Prescribed Fire would likely result in the additional creation of snags and could have negligible beneficial effects on improving bald eagle habitat (nest and perch trees) near river corridors. Other potential impacts to these species from smoke, catastrophic fires, etc. would be similar to those described above for northern spotted owls and marbled murrelets. If nesting bald eagles were found in the park, use of helicopters during Fire Suppression would be allowed no lower than 1,300 feet above the canopy, rather than the 2,600 feet recommended for marbled murrelets and northern spotted owls, although individual site characteristics may warrant other variable buffer distances.

Under the Alternatives involving Fire Suppression (1- 5) or Wildland Fire Use (2- 5), as described in this Environmental Assessment, impacts to bald eagles could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. Prescribed Fire (3 and 5), under future environmental analysis, would either avoid nesting or spawning seasons or would not be conducted in areas where analysis of rare species and habitat had not been made. As a result, alternatives involving Prescribed Fire (3 and 5) would have either no effect or would be not likely to adversely affect or would beneficially affect bald eagles. As mentioned above, Alternatives that include Hazard Fuel Reduction would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Peregrine Falcons
Since the only known potential nesting of peregrine falcons occurs in the vicinity of the southwest portion of the park, and since that rocky area is similar to other rocky areas that would be used by nesting peregrines and would not be able to carry fire, it is likely that potential effects to nesting peregrines would be negligible to minor or would be beneficial, resulting in better prey habitat. Other potential impacts to these species from smoke, catastrophic fires, etc. would be similar to those described above for northern spotted owls and marbled murrelets.

Under the Alternatives involving Fire Suppression (1- 5) or Wildland Fire Use (2- 5), as described in this Environmental Assessment, impacts to peregrine falcons could range from no effect to not likely to

adversely affect to beneficial effects, depending on the fire location, severity and extent. Prescribed Fire (3 and 5), under future environmental analysis, would either avoid nesting or spawning seasons or would not be conducted in areas where analysis of rare species and habitat had not been made. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects or they would not be conducted within known or potential habitat.

Impacts of Alternatives 1-5 on Northern Goshawks or Ferruginous Hawks
Potential impacts to these species would be similar to those described above for northern spotted owls and marbled murrelets. Under the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire, as described in this Environmental Assessment, impacts to northern goshawks or ferruginous hawks could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Olive-Sided Flycatchers
Potential impacts to these species would be similar to those described above for northern spotted owls and marbled murrelets. Under the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire, as described in this Environmental Assessment, impacts could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

MAMMALS
Impacts of Alternatives 1-5 on Gray Wolves
There have been no confirmed records of gray wolves living in the park in the last 80 years. Numerous observations did occur from the late 1800s through the 1920s. Sporadic reports of possible wolves have occurred over the years by the public and park employees (most in the northern or eastern sections of the park). None have been confirmed by biologists despite many being investigated. No specific surveys for wolves have been conducted. However, they would be detectable in recent systematic winter track counts, camera scent station analyses and hair snag analyses conducted for mid- sized forest carnivores. None have been detected by these surveys. Impacts to Gray Wolves would be the same as those that would occur to other species as generally described in the introduction to *Rare, Threatened and Endangered Wildlife*. Under the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire, as described in this Environmental Assessment, impacts could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Canada Lynx, Pacific Fisher and California Wolverine
The last reliable information documenting the occurrence of these species was in the 1920s for lynx, in 1933 for wolverine and in 1947 for fishers. In recent specific surveys (systematic winter track counts, camera scent station and hair snag analyses) for forest carnivores, none have been detected. Impacts to lynx, wolverine and fishers would be the same as those that would occur to other species as generally described in the introduction to *Rare, Threatened and Endangered Wildlife*. Under the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire, as described in this Environmental Assessment, impacts could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Grizzly Bears

Grizzlies have never been documented in the park. No specific surveys, however, have been conducted. Detection of grizzlies, however, would be possible in the recent systematic surveys conducted for other medium- sized forest carnivores. None, however, have been detected. Periodic, low intensity fires can promote and maintain many important berry- producing shrubs and forbs. Impacts to grizzlies would be the same as those that would occur to other species as generally described in the introduction to *Rare, Threatened and Endangered Wildlife*. Under the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire, as described in this Environmental Assessment, impacts could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Rare Bats, including the Long-eared Myotis, Long-legged Myotis, and Pacific Townsend's Big-Eared Bat

Impacts to rare bats would be generally the same as those that would occur to other species as described in the introduction to *Rare, Threatened and Endangered Wildlife*. Other unknown effects would also occur. Under the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire, as described in this Environmental Assessment, impacts could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Rare, Threatened or Endangered Fish, including Chinook Salmon, Bull Trout/Dolly Varden, Coho Salmon, and Coastal Cutthroat Trout

As described above under potential effects to rare, threatened or endangered species and in the section above on *Fish*, special status fish could be affected by Fire Suppression, Wildland Fire Use or Prescribed Fire. Although it is unlikely, during Prescribed Fires or Wildland Fire Use, riparian vegetation could be burned to the extent that stream temperatures would rise and fish would be affected during catastrophic wildland fire. If such changes in riparian habitat occurred or if extensive fires caused major erosion or ash deposits in area rivers or streams, it is likely that fish would be affected. As with other park species, however, fish have evolved in response to periodic disturbance by fire and it is reasonable that they would persist under Alternatives that would involve Wildland Fire Use or Prescribed Fire. To the extent possible, Alternatives that involve these management strategies would avoid impacts during the spawning seasons of these fish – for instance the maximum manageable area of a Prescribed Fire could be contained to areas where such impacts would be limited or would not occur. Overall, fires would likely result in long- term beneficial effects to fish by increasing the nature and extent of woody debris in streams and rivers. For species such as bull trout/dolly varden, their widespread persistence in the park would result in a greater ability to withstand catastrophic wildland fire events, since they would be able to move from areas of abundance to areas of depletion with watersheds.

In addition to the above, impacts to rare fish would generally be as described in the introduction to *Rare, Threatened and Endangered Wildlife*. Under the Alternatives involving Fire Suppression (1- 5) or Wildland Fire Use (2- 5), as described in this Environmental Assessment, impacts could range from no effect to not likely to adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Impacts of Alternatives 1-5 on Rare Amphibians, including the Red-legged Frog, Tailed Frog, Cascades Frog, Larch Mountain Salamander, Van Dyke's Salamanders and Aquatic Invertebrates, including the California Floater and Fender's Soliperlan Stonefly

Impacts to aquatic and terrestrial amphibians would be similar to those described for fish above. As above, they would also be generally the same as those described in the introduction to *Rare, Threatened and Endangered Wildlife*. Under the Alternatives involving Fire Suppression, Wildland Fire Use or Prescribed Fire, as described in this Environmental Assessment, impacts could range from no effect to not likely to

adversely affect to beneficial effects, depending on the fire location, severity and extent. As mentioned above, Alternatives that include Hazard Fuel Reduction (1, 4 and 5) or Prescribed Fire (3 and 5) would either have no effect, be not likely to adversely affect or would have beneficial effects.

Summary/Cumulative Impacts: The above described range of potential impacts for Alternatives 2- 5 would vary widely individually and cumulatively but would not impair park rare, threatened or endangered wildlife or the values for which they have been protected in Mount Rainier National Park.

Prehistoric and Historic Archeology

The effects of fire on prehistoric sites are variable, with particular concerns associated with rock art sites and sites with dense, surface- visible lithic scatters. In general, sites with shallowly buried deposits or features tend not to be impacted by most low intensity fires due to the ability of soil to insulate these against the extreme heat of fires.

Fires often represent an extraordinary opportunity to document archeological sites. Dense vegetation that obscures the ground surface is often consumed and its removal results in the ability to document heretofore- unidentified sites. Fires may also present the challenge of protecting archeological sites from the damaging effects of natural erosion, site vandalism (pot hunting) and inadvertent damage as a result of fire suppression activities or post- fire rehabilitation efforts. Most of the park's developed areas, trails and other facilities were constructed prior to the advent of cultural and archeological resources protection laws. Accordingly, the extent of damage to park archeological resources by the construction of these facilities was not assessed at that time.

The effect of fires on prehistoric or historic archeological resources depends on the location, severity, extent and timing of the fire. There are variable effects based on the fire intensity, duration of heat, heat penetration of the soil, the use of suppression equipment and other factors. Fires may result in:

- loss or damage of physical artifacts (dependent on construction material – e.g. wood, shell, masonry, clay, stone, bone, plant or other organic material, etc. – and context – soil, rock shelter, surface deposit, buried deposit, etc.);
- loss or damage to contextual information, including compaction, erosion and partial or complete consumption of organic matter;
- inability to relocate previously identified archeological sites without vegetation context;
- the ability to locate previously undetected cultural resources obscured by vegetation;
- an increased potential for vandalism to archeological sites;
- an increased knowledge of the areal extent of archeological context for previously recorded sites due to exposure of other site features;
- a change in the potential of for long- term preservation of artifacts (i.e. artifacts may become more brittle);
- consumption of or decreased potential to detect some archeological resources for instance charred surficial deposits of bone, etc.;
- (through the use of low intensity prescribed fire or hazard fuel reduction in some alternatives) the ability to increase protection for or avoid impacts to known archeological sites.

To minimize or eliminate potential impacts to archeological resources,

- The park would continue to build on its inventory and monitoring program for archeological resources, including conducting surface and subsurface testing as necessary to document the potential for archeological resources or to understand the extent of archeological resources found.
- Prior to the development of Prescribed Fire plans (and subsequent environmental analysis), areas proposed for fires would be surveyed for the presence of archeological resources. Post- burn surveys would also be conducted.
- Heavy equipment or other ground disturbing activities would not be used in known sensitive archeological resources sites.

- The location and extent of known sensitive archeological resources would be considered in the decision to use wildland or prescribed fire.
- Inclusion of park archeologist would occur in the planning and suppression process. The archeologist would also accompany crews to assist in identification of a fireline rout that would avoid damage to known resources in sensitive areas.
- There would be no fire line construction in the vicinity of known archeological resources.
- During archeological assessment and monitoring there would be surface or subsurface surveys accompanied by screening of sediments as necessary to determine the presence or significance of archeological resources.
- If prehistoric or historic archeological resources were discovered during any portion of a proposed action under the implementation of the alternatives that follow, work in the area associated with the find would cease until evaluated by the park archeologist or designated representative. If necessary or possible, relocation of the work to a non- sensitive area may be required to enable completion of additional site testing and documentation. Every effort would be made to avoid further disturbance to the site.
- In the event of a significant find, consultation with the Washington State Historic Preservation Office and Native American tribes would occur and recommendations would be sought for appropriate treatment of the resources located.
- Increased law enforcement patrols in known archeological sites following fires that removed surface vegetation obscuring sites.
- Confinement of mop- up activities to smaller areas to allow archeologists more lead time to examine the ground surface before crews complete their work.

Alternative 1 Prehistoric and Historic Archeological Impacts

Fire Suppression: Despite the intent of this Alternative to suppress all human- caused and naturally- ignited wildland fires, this Alternative would result in a moderate number of small fires and a small number of larger fires. Depending on the location of ignition, extent and severity of the fire prior to suppression and other factors, these would result in negligible to moderate impacts to prehistoric and historic archeological resources, including the array of impacts discussed above. Fires would likely have greater impacts on historic archeological resources than on prehistoric archeological resources, due to the subsurface context of the greatest percentage of the latter and the wood content of the former. Because a relatively high percentage of the park's prehistoric archeological record is found in a subsurface context, heat damage from fires is not expected to be as great as occurs elsewhere in environments with lower natural deposition. As a result, the mitigation strategies described above that would minimize or eliminate impacts to known archeological resources would be employed. In addition, other mitigation strategies, described in other resource analyses would likely result in fewer impacts to archeological resources. As needed, under this and other alternatives, there would be increased law enforcement patrols of cultural resources sites, including historic structures and exposed archeological sites, particularly in areas readily accessible to the public following park fires.

Hazard Fuel Reduction (Limited Debris Burning): Since this activity would be conducted only within designated areas which have been analyzed for the presence of archeological resources, there would be no effect on prehistoric or historic archeological resources as a result of the implementation of this portion of Alternative 1.

Hazard Fuel Reduction (Limited Manual/Mechanical Treatment): These activities would be conducted under controlled situations and after assessment of potential impacts to prehistoric and historic archeological resources. If the potential to impact archeological resources was identified, these activities would not be conducted. If previously unidentified archeological resources were encountered the above mitigation strategies to prevent further disturbance and to assess the significance of these would be implemented. There would be no or negligible effects to archeological resources as a result of this fire management activity.

Alternative 2 Prehistoric and Historic Archeological Impacts
Impacts associated with Fire Suppression under this Alternative would be the same as those described above under Alternative 1.

Wildland Fire Use: Because the extent of fires would be greater under this Alternative than under Alternative 1, but the decision to use wildland fire would be based on analysis of impacts to archeological resources, impacts would continue to range from negligible to moderate depending on the location, extent, severity and timing of a fire, as well as the type of prehistoric or historic archeological resources present. As in Alternative 1, the impact of fire management activities on prehistoric or historic archeological resources would result in negligible to moderate impacts, including the array of impacts discussed above. As above, mitigation strategies that would minimize or eliminate impacts to known archeological resources would be employed. Without the use of Hazard Fuel Reduction under this Alternative, there would be a slight increase in the possibility of impacts to prehistoric and historic archeological resources.

Alternative 3 Prehistoric and Historic Archeological Impacts
Impacts associated with Fire Suppression would be the same as Alternative 1 and impacts associated with Wildland Fire Use would be similar to Alternative 2. Prescribed Fire, as mentioned in earlier analyses, would likely substitute for some Wildland Fire Use and vice versa, so the overall impacts could be somewhat less.

Prescribed Fire: Prior to selection of Prescribed Fire as a management strategy, archeological surveys and analysis would be conducted. Use of prescribed fire or carefully controlled Wildland Fire Use would likely be the preferred management strategy in areas where known prehistoric or historic archeological resources were present. If, however, fire would result in damage to such resources, it would be avoided in these areas. As a result, implementation of Prescribed Fire would tend to have fewer potential (negligible to minor) impacts on archeological resources than either Fire Suppression or Wildland Fire Use, since the potential fire area would have been surveyed prior to ignition and use of fire either would not occur or would be modified in sensitive archeological resources sites.

Alternative 4 Prehistoric and Historic Archeological Impacts
Impacts associated with Fire Suppression would be the same as Alternative 1 and impacts associated with Wildland Fire Use would be the same as Alternative2.

Hazard Fuel Reduction (Debris Burning and Manual/Mechanical Treatment): Impacts associated with even the more comprehensive implementation of this fire management strategy would be the same as Alternative 1.

Alternative 5 Prehistoric and Historic Archeological Impacts
This Alternative would result in the same Fire Suppression impacts as Alternative 1, the same Wildland Fire impacts as Alternative 2, the same Prescribed Fire impacts as Alternative 3, and the same Hazard Fuel Reduction impacts as Alternative 4.

Summary/Cumulative Impacts: In all alternatives, there would be a potential for negligible to moderate impacts to prehistoric and historic archeological resources that would depend on the location, severity, timing and extent of the fire. With the above- listed mitigation strategies, these impacts would be the same individually as cumulatively. The above described range of potential impacts (Alternatives 1- 5) would not impair park archeological resources or the values for which they have been protected in Mount Rainier National Park.

Historic Structures
With 158 buildings and structures listed as part of the Mount Rainier NHLD, six historic districts, and five National Historic Landmark (NHL) buildings, fire related impacts to park historic structures could be varied and widespread. Of particular concern would be the loss or damage of buildings or structures listed

on the National Register. In addition, such loss would likely result in impacts to the more comprehensive architectural historic districts or the all- encompassing NHLD.

Fire related impacts to historic structures would be dependent on the location, severity, extent and timing of the fire, and similar to those described for archeological resources. There would be variable effects based on the fire intensity, duration of heat, heat penetration of the soil, the use of suppression equipment and other factors, namely:

- loss or damage of physical buildings or structures (the scale would be dependent on construction material – e.g. wood, masonry, stone, etc. – and context – within a major or minor developed area or within a wilderness location);
- loss or damage to contextual information, including compaction or erosion;
- a slight increase in the ability to locate previously undetected cultural resources obscured by vegetation, depending on the construction of the building or structure;
- an increased potential for vandalism;
- a slight increase in the potential for expansion of areal extent, or context for previously recorded sites due to exposure of other site features;
- a change in the potential of for long- term preservation (i.e. stone or masonry structures may become more brittle);
- consumption of or decreased potential to detect some historic resources, for instance loss of old sections of wood- stave water pipes;
- (through the use of low intensity prescribed fire or hazard fuel reduction under some alternatives) the ability to increase protection for or avoid impacts to historic buildings or structures.

Similar to other potential fire effects in other resource analyses, the park would employ wide range of strategies to minimize or eliminate potential impacts to historic buildings and structures.

- The park would continue to build on its inventory and monitoring program for historic resources.
- Prior to the development of Prescribed Fire plans (and subsequent environmental analysis), areas proposed for fires would be surveyed for the presence of historic resources.
- Heavy equipment or other ground disturbing activities would not be used in known sensitive archeological resources sites.
- The location and extent of known sensitive or significant historic resources would be considered in the decision to use wildland or prescribed fire.
- Inclusion of park historical architect and historical landscape architect in the planning and suppression process.
- There would be no fire line construction in the vicinity of known historic resources.
- If historic resources were discovered or affected during any portion of a proposed action under the implementation of the alternatives that follow, consultation with the State Historic Preservation Office would occur. If necessary or possible, relocation of the work to a non- sensitive area may be required to enable completion of consultation and documentation. Every effort would be made to avoid further disturbance to the site.
- Increased law enforcement patrols would occur near affected resources following fires.
- Confinement of mop- up activities to smaller areas to allow historic resources professionals more lead time to understand fire effects to historic resources.
- Structural inspections (post- fire condition assessment) of historic structures damaged by fire, including immediate mitigation measures such as bracing or weatherproofing.

Alternative 1 Historic Structures Impacts

Fire Suppression: As described, despite the intent of this Alternative to suppress all human- caused and naturally- ignited wildland fires, this Alternative would result in a moderate number of primarily small fires and a small number of larger fires. Depending on the location of ignition, extent and severity of the fire prior to suppression and other factors, these could result in negligible to major impacts to historic buildings and structures, including the array of impacts discussed above. As a result, the mitigation strategies described

above that would minimize or eliminate impacts would be employed. In addition, other mitigation strategies (described in other resource analyses) would likely result in additional minimization of impacts to historic resources.

Hazard Fuel Reduction (Limited Debris Burning): Since this activity would be conducted only within designated areas, where there are no historic structures or buildings in the debris burning locations, there would be no effect on historic buildings or structures as a result of the implementation of this portion of Alternative 1.

Hazard Fuel Reduction (Limited Manual/Mechanical Treatment): These activities would be conducted under controlled situations, planned in advance and after assessment of potential impacts to historic buildings and structures. If the action would impact historic buildings or structures, it would not be conducted. There would be no or negligible effects to historic buildings and structures as a result of this fire management activity.

Alternative 2 Historic Structures Impacts
Impacts associated with Fire Suppression under this Alternative would be the same as those described above under Alternative 1.

Wildland Fire Use: Because the extent of fires would be greater under this Alternative than under Alternative 1, the decision to use wildland fire would be based on analysis of impacts to historic buildings and structures. Impacts would continue to range from negligible to major, depending on the location, extent, severity and timing of a fire, as well as the type of historic resources present. As in Alternative 1, the impact of fire management activities would result in the array of impacts discussed above. As above, mitigation strategies that would minimize or eliminate impacts to historic building and structures would be employed. Without the use of Hazard Fuel Reduction under this Alternative, there would be a slight increase in the possibility of impacts to historic buildings and structures.

Alternative 3 Historic Structures Impacts
Impacts associated with Fire Suppression would be the same as Alternative 1 and impacts associated with Wildland Fire Use would be similar to Alternative 2. However, as mentioned earlier, Prescribed Fire would likely substitute for some Wildland Fire Use and vice versa, so the overall impacts could be somewhat less.

Prescribed Fire: Prior to selection of Prescribed Fire as a management strategy, analysis of its potential impacts on historic buildings and structures would be conducted. Use of prescribed fire or carefully controlled Wildland Fire Use would likely be the preferred management strategy in areas where known historic resources were present. If fire would result in damage to such resources, it would be avoided in these areas. As a result, implementation of Prescribed Fire would tend to have fewer potential (negligible to minor) impacts on historic resources than either Fire Suppression or Wildland Fire Use. This is because the potential fire area would have been analyzed prior to ignition and use of fire either would not occur or would be modified to eliminate impacts to these resources.

Alternative 4 Historic Structures Impacts
Impacts associated with Fire Suppression would be the same as Alternative 1 and impacts associated with Wildland Fire Use would be the same as Alternative 2.

Hazard Fuel Reduction (Debris Burning and Manual/Mechanical Treatment): Impacts on historic structures associated with even the more comprehensive implementation of this fire management strategy would be the same as Alternative 1.

Alternative 5 Historic Structures Impacts

This Alternative would result in the same Fire Suppression impacts as Alternative 1, the same Wildland Fire impacts as Alternative 2, the same Prescribed Fire impacts as Alternative 3, and the same Hazard Fuel Reduction impacts as Alternative 4.

Summary/Cumulative Impacts: Alternative 2 would have the greatest potential to result in impacts to historic structures since it does not include prescribed fire or hazard fuel reduction, which could be used to more effectively protect historic structures. Alternative 1 also has a greater potential to result in catastrophic fires as a result of its longer- term alteration of the park's natural fire regime over time. The above- described range of potential impacts (Alternatives 1- 5) would be mitigated to the extent possible to prevent impairment of historic structures. As a result, these Alternatives would not result in impairment of historic structures or the values for which they have been protected in Mount Rainier National Park.

Cultural Landscapes (Mount Rainier National Historic Landmark District)
Impacts to cultural landscapes, including the Mount Rainier NHLD, are characterized with respect to the following characteristics (See *Affected Environment: Mount Rainier NHLD* for definitions): spatial organization, circulation, topography, vegetation, structures, and buildings.

Alternative 1 NHLD Impacts
Fire Suppression: There would be no changes with respect to topography as a NHLD characteristic with the use of Fire Suppression. There could be negligible to minor temporary effects on circulation as roads or areas were closed during Fire Suppression activities. Effects on buildings and structures would be the same as discussed above under the analysis of Fire Suppression on *Historic Structures*. Effects on vegetation would be similar to those discussed above under Fire Suppression on Vegetation. As such, they would include negligible to moderate short and long- term changes in area landscapes, including scenic quality and ecosystem processes, depending on the location, timing, extent, and severity of the fire. Under this Alternative, these changes would be expected to be minor, with most fires suppressed when relatively small. Since, however, full suppression would be undertaken with each fire start, whether human or lightning, there could be a negligible to moderate increase in the presence of constructed fire lines throughout the park. Although rehabilitation would take place, these would continue to be visible for some time after the fire, depending on the vegetation type and proximity to resources included in the NHLD. To the degree that protection measures would focus on NHLD buildings and structures, these would be somewhat more prevalent in developed areas affected by fire starts.

Hazard Fuel Reduction (Limited Debris Burning): There would be no effect on NHLD characteristics as a result of this activity.

Hazard Fuel Reduction (Limited Manual/Mechanical Treatment): There would be a negligible to minor beneficial effects on the preservation of historic structures as a result of even limited implementation of this activity in developed areas. There would be negligible effects on landscaped vegetation characteristics around historic structures in developed areas as a result of this activity. These effects would minor trimming or vegetation removal around the structure. Although this activity would be conducted in an effort to increase defensible space around historic structures, as mentioned, most structures are of wood construction (although they may have concrete and stone faced foundations and other features) and most have cedar- shingle roofs. As a result, creating defensible space around these structures is not of high consequence, since wind carried sparks could result in fires that consume them. In summary, this Alternative would have some beneficial effects and some neutral or adverse effects on NHLD characteristics. There would be no or negligible effects on circulation, no effects on topography, and no effects on spatial organization as a result of this Alternative.

Alternative 2 NHLD Impacts
Fire Suppression impacts would be the same as Alternative 1.

Wildland Fire Use: Effects on NHLD characteristics would be similar to effects described under Fire Suppression for Alternative 1 above, except that these would have the potential to be somewhat greater as a result of parkwide use of wildland fire; that is, an increase in the number of acres burned would result in greater potential impacts to the NHLD. There would continue to be no changes with respect to topography as a NHLD characteristic with the use of Fire Suppression. There could be negligible to minor temporary effects on circulation as roads or areas were closed during Fire Suppression activities. For instance, access to a portion of the park could be closed for several weeks to non- administrative use. Although it would be unlikely, fires could cause short- term closures of park roads by making these unsafe for reopening. Effects on Buildings and Structures would be the same as discussed above under the analysis of Fire Suppression and Wildland Fire Use on *Historic Structures*. Effects on vegetation would be similar to those discussed above under Fire Suppression and Wildland Fire Use on Vegetation. As such, they would include negligible to moderate short and long- term changes in area landscapes, including scenic quality and ecosystem processes, depending on the location, timing, extent, and severity of the fire. Under this Alternative, these changes would be greater than those under Alternative 1, with an increased potential for larger fires to occur. Although rehabilitation would take place, fire lines would continue to be visible for some time after the fire, depending on the vegetation type and proximity to resources included in the NHLD. To the degree that protection measures would focus on NHLD buildings and structures, these would be somewhat more prevalent in developed areas affected by fire starts.

Alternative 3 NHLD Impacts

Fire Suppression impacts would be the same as Alternative 1 and Wildland Fire Use impacts would be the same as Alternative 2 however as mentioned earlier, Prescribed Fire would likely substitute for some Wildland Fire Use and vice versa, so the overall impacts could be somewhat less.

Prescribed Fire: Prior to selection of Prescribed Fire as a management strategy, analysis of its potential impacts on the NHLD would be conducted. Use of prescribed fire or carefully controlled Wildland Fire Use would likely be the preferred management strategy in areas where known historic resources were present. If, however, fire would result in damage to such resources, it would be avoided in these areas. As a result, implementation of Prescribed Fire would tend to have fewer potential (negligible to minor) impacts on historic resources than either Fire Suppression or Wildland Fire Use, since the potential fire area would have been analyzed prior to ignition and use of fire either would not occur or would be modified to eliminate impacts to these resources. There would be no impacts from Prescribed Fire to spatial organization or topography and more limited (negligible) effects would occur with respect to circulation.

Alternative 4 NHLD Impacts

This Alternative would result in the same impacts as Alternative 2, except with respect to Hazard Fuel Reduction as described below.

Hazard Fuel Reduction (Manual/Mechanical Treatment): As in Alternative 1, there would be a negligible to minor beneficial effects on the preservation of historic structures as a result of even limited implementation of this activity in developed areas. There would be negligible to minor effects on landscaped vegetation characteristics around historic structures, in developed areas, as a result of this activity. These effects would include potential changes in the structure, composition and density of vegetation allowed near historic structures. Although this activity would be conducted in an effort to increase defensible space around historic structures, as mentioned, most structures are of wood construction (although they may have concrete and stone faced foundations and other features) and most have cedar- shingle roofs. As a result, creating defensible space around these structures is not of high consequence, since wind carried sparks could result in fires that consume them. As a result, this Alternative would have some beneficial effects and some neutral or adverse effects on historic structures. There would be no or negligible effects on circulation, no effects on topography, and no effects on spatial organization as a result of this Alternative.

Alternative 5 NHLD Impacts

This Alternative would result in the same Fire Suppression Impacts and Wildland Fire Use Impacts as Alternative 2, the same Prescribed Fire Impacts as Alternative 3 and the same Hazard Fuel Reduction Impacts as Alternative 4. Overall, since there would be more options to enhance the landscape characteristics of the NHLD and an increased ability to protect historic structures and landscapes with the use of both Hazard Fuel Reduction and Prescribed Fire, implementation of this Alternative would likely result in a negligible to minor long- term benefit to the NHLD.

Summary/Cumulative Impacts: These would be the same as described above for historic structures.

Ethnography

Alternatives 1-5 Ethnographic Impacts

Although fires could result in landscape level vegetation changes over a localized or widespread area, they would be extremely unlikely to affect all areas where plant communities occur. Where huckleberries occur or where fires increased meadow areas, they would likely result in increased huckleberry production, which is considered important to Native Americans. In addition, they would result in increased wildlife presence in new forest openings. In addition, they would not result in other than negligible effects on topography and thus would not disturb areas where potential ethnographic resources are located. As the park's understanding of ethnographic resources grows, known ethnographic resources would be protected in the same way as known archeological, historic or sensitive plant resources. The Alternatives described herein, therefore, would have no or only negligible effects on potential ethnographic resources. Ongoing consultation with Native American Tribes regarding potential prescribed fire plans, as they are developed would ensure that the plans would reflect concerns of both the park and the tribes.

Summary/Cumulative Impacts: There could be negligible short and long- term cumulative impacts from the implementation of the proposed alternatives (1- 5) that because of avoidance or mitigation strategies would not result in impairment of ethnographic resources or their values in Mount Rainier National Park.

WILDERNESS

Park wilderness values include natural, ecological, geological, cultural, scenic, scientific and recreational opportunities. Wilderness impact analysis is required by Section 4 (c) of the Act, which prohibits certain activities in wilderness by the public, and at the same time, allows agencies to engage in those activities in some situations:

> ". . .except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Therefore, Congress acknowledged that even though certain activities are prohibited, there are times when exceptions to these prohibitions will need to be made for administration of the area. As a result, analysis of activities in wilderness involves analysis of the "minimum requirements" for administration and very often, analysis of the "minimum tool" as well since the use motorized equipment and mechanical transport are specifically regulated.

The objectives for park fire management include restoring naturally- ignited wildland fire to the park, including wilderness, and doing so in a manner that puts a high priority of visitor and employee safety and the preservation of park resources (see *Fire Management Objectives* section). Many of the proposed actions under the alternatives described herein would be conducted regularly or routinely in the park; others would be conducted periodically; and still others would be conducted only during an emergency.

All alternatives may result in temporary impacts to wilderness character, particularly related to impacts on wilderness visitors, including the perception of solitude and a primitive, unconfined wilderness experience. These impacts would include the use of aircraft to detect, monitor and manage fires, as well as noise and

activity from firefighting staff and equipment during operations. All fire operations in the wilderness would consider preservation of wilderness character and experiences in their implementation. Fire activities would be conducted following the minimum requirement concept. Minimum Impact Suppression Tactics (MIST)(FMP Appendix 23) would be used to reduce or eliminate wilderness impacts. Following significant fire suppression actions, burned area emergency rehabilitation plans may be implemented under the direction of the fire management officer and the recommendations of a resource advisor.

The following administrative criteria and MIST would be applied to wilderness impacts related to the implementation of the park fire management program.

- Administrative use of aircraft would be permitted in accordance with Office Order 97- 1: Safety Orientation for New Employees and 79- 8: Aircraft Use Request (see FMP **Appendices**) and subsequent updates. Permission to use helicopters in wilderness must be specifically granted by the superintendent. Helicopter use in wilderness (for other than emergencies) would generally not be approved between July 1 and Labor Day and use at other times is generally restricted to weekdays. Approval for helicopter use in non- emergency situations would be granted only if it has been determined to be the minimum tool to achieve the purposes of the area for protection of wilderness values (See Environmental Assessment Appendices 2 and 1 and Fire Management Plan Appendix 30).
- There are no existing helicopter landing zones constructed in park wilderness. Natural openings would be used if approved under the minimum requirement for helicopter landing as detailed in the FMP. Minimal clearing would be used in an emergency if other safe alternatives have been ruled out. Site restoration would occur following this use.
- Fixed wing and other aircraft use would conform to FAA regulations and mitigation strategies to reduce or eliminate impacts to endangered species.+
- As detailed in the Wilderness Management Plan (1988), temporary work crew camps may be established within trailside camps or other resilient zones as approved by the superintendent (but not within view or ¼ mile from established trails). Cache boxes, equipment and supplies would be kept out of sight as possible and removed when no longer needed and restoration would occur upon cessation of use.
- Park use of power equipment is dictated by Office Order 87- 1: NPS Use of Mechanized Equipment and Stock for Administrative Activities Otherwise Not Permitted and the Wilderness Management Plan. The use of Manual/Mechanical equipment is constrained by the Wilderness Act and NPS policy. In determining the appropriate minimum tool for use in wilderness, consideration is given to effects on visitor experience, public safety and wilderness values. Resource protection and safety concerns would take precedence over economic considerations. Alternative methods to power tools would be considered based on the project objectives and minimum tool concerns. Use of power tools in wilderness would be confined, as much as possible, to the period prior to July 1 and after August 31 to avoid impacts to most visitors' experiences.
- As discussed in the Wilderness Management Plan, the use of the minimum requirement/minimum tool concept would be employed for fires in wilderness. Specific emphasis would be on the natural role of fire in the park ecosystem and the need to modify fire use and fire suppression responses (as appropriate) to minimize their effects. Suppression standards (both tactical and strategic) would be used to reduce the environmental effects of suppression. Rehabilitation of fire suppression impacts to park resources would occur as part of and immediately following mop- up.

Alternative 1 Wilderness Impacts

Fire Suppression: Under this Alternative, all human- caused and naturally ignited wildland fires would be suppressed. With this fire management strategy determining the presence of fire in the park, there would be a minor to major adverse effect on natural and ecological values of park wilderness. The park's natural fire regimes, which vary according to location on the east or west side of the park and other factors, would become uniform. The nearly 100 years of fire suppression on the park, which has likely had little overall

holistic impact on the park's 465 year fire regime on the west side of the park, would begin to have minor to major effects on the persistence of some species. The minor to moderate effects of fire suppression on the east side of the park would increase in impact. Continued indefinitely, this practice would gradually lead to significant changes in vegetation patterns and wildlife population dynamics and distribution and would therefore adversely affect other natural and scenic qualities of park wilderness. There would be no direct effect on park geological, scientific, cultural, social or recreational values. Indirect effects on scientific values would include eliminating the ability of scientists to study the natural disturbance and successional processes associated with small to large naturally- ignited wildland fires. Although there would be no direct effects on park cultural resources, indirect effects would include not considering the use of naturally ignited or prescribed fires to restore cultural landscapes or ethnographic resources. Over time, particularly during long- term drought, there would be an increased potential for fire to move through habitats where it was long absent, resulting in potentially unnatural fuel loads ready to burn. This would in turn affect the persistence of specimen trees and/or wetland and riparian areas that might have survived a fast moving moderate fire. It could also result in the loss of historic structures, buildings and administrative facilities used in the recreation in and management of park resources, including wilderness. Indirect effects on social or recreational values, as well as other indirect effects on scenic values, could result in increasing the potential for stand- replacing catastrophic fires as fuel loads increased. These would result in extensive, high cost fire suppression responses, and would increase the array and intrusion of mechanized equipment in wilderness to fight the fire.

Under any Fire Suppression scenario (and there would be many efforts under a total fire suppression strategy), there would be a range of impacts to wilderness. These would include impacts to recreational and social values as well as and the opportunities for solitude and a primitive unconfined recreational experience. Most of these impacts would be temporary in nature and would persist only over the duration of the fire and mop- up. The results of firefighting efforts on other wilderness values, including scenic qualities and natural values, would be difficult to distinguish. Most visitors would likely not be able to determine where firefighters had worked versus the natural appearance of a burn in wilderness. There would, however, be minor to moderate impacts, including the construction of fire lines, temporary helispots and camps. Other effects would include felled or bucked trees, cut brush and bare soil. These impacts would be reduced to the degree possible through minimum impact suppression techniques (MIST see FMP Appendix 23). Post- fire rehabilitation and mop- up would reduce some of the impacts of large fire suppression activities.

To enhance firefighter and public safety, to access difficult terrain, and to protect park resource values at risk, the use of chainsaws, portable pumps, helicopters and fixed wing aircraft are all often considered minimum tools for fire suppression activities. A variety of communications systems would also be used. In addition, as mentioned, fire suppression activities would result in the use of water from park lakes and rivers, and chemical fire retardant and foams as necessary to extinguish fires. The potential use of this and other equipment would necessarily depend on the location, timing, accessibility and extent of the fire. Not all fires, however, would use power tools or mechanized transport. Easily accessible fires would be fought using basic firefighting tools, such as shovels, Pulaskis, and McLeods. A small number of fires would be suppressed via confinement using natural boundaries.

As a result of the use of aircraft and motorized equipment (and of the natural ecological effects of fire (including smoke, flames and other associated impacts), recreational impacts to park wilderness visitors would include:

- temporary closures of portions of the park;
- temporary loss of the feeling of a primitive recreational experience in the vicinity of firefighting efforts;
- temporary minor to moderate noise and disturbance in the vicinity of the firefighting efforts with a consequent loss of wilderness solitude; as well as
- increased activity and congestion in other areas of the park related to firefighting.

Since most fires would be suppressed when still quite small, these impacts would be minor. With the occasional larger fire, however, moderate impacts to park wilderness visitors could result.

Hazard Fuel Reduction (debris burning): Under this and other alternatives, this activity would take place at designated areas, including potential areas located near historic structures in wilderness. Debris burning would be conducted under established conditions would, therefore, have negligible to minor effects on wilderness. Such negligible effects would be the ability to smell smoke in the vicinity of the area.

Hazard Fuel Reduction (Manual/Mechanical treatment): Under this Alternative, this activity would take place only in major developed areas and along roadsides, which are excluded from the park wilderness. There would be no effect on park wilderness as a result of this activity.

Alternative 2 Wilderness Impacts

Under this Alternative, impacts related to wildland fire suppression would be similar to those in Alternative 1. The primary difference would be related to the increased need for mop- up of larger fire areas related to the implementation of Wildland Fire Use as described below. The same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park wilderness. There would be no Hazard Fuel Reduction, and therefore no impacts from that activity under this Alternative.

Wildland Fire Use: Under this fire management strategy, there would be beneficial impacts on the natural, ecological, scenic, scientific, cultural and recreational values of wilderness. The management of naturally occurring wildland fire is considered critical to maintaining park ecosystems. Depending on the location, extent, severity and timing of the fire, minor to major beneficial impacts would include:

- restoration of the natural ecological role of fire to park wilderness;
- fewer recreational (noise and disturbance) and scenic impacts related to fire suppression activities,
- the ability to study the natural role of disturbances, including fire on park ecosystems;
- increased ability to enhance the preservation of cultural resources by mitigating the potential for catastrophic fire in wilderness surrounding developed areas;
- better preservation of park vegetation and wildlife, which have evolved in the presence of periodic natural disturbance by fire;
- increased scenic diversity in park vegetation communities; and
- increased opportunities to see wildlife due to increased diversity in vegetation communities.

Adverse impacts would continue to be minor to major and would be the same as those described above under *Alternative 1: Fire Suppression*. There would be, however, a potential increase in short- term firefighting efforts when wildland fires exceeded their beneficial resource objectives or weather patterns resulted in the need for fire suppression rather than use. While most Wildland Fire Use would result in small to moderate- sized fires (1- 2,500 acres), occasional larger fires could result. In general, even these small to moderate fires would be larger than those under only a Fire Suppression strategy. Therefore, greater impacts related to wildland fire management, including helicopter and ground surveillance, monitoring, and, if needed, suppression, would result. These impacts would continue to be minor to major depending on the need for suppression, the location, timing, severity and extent of the fire.

Alternative 3 Wilderness Impacts

Impacts related to Fire Suppression and Wildland Fire Use under this Alternative would be the same as Alternative 2. There would continue to be no Hazard Fuel Reduction under this Alternative, and therefore no impacts related to that fire management activity.

Prescribed Fire: There would be minor to moderate effects on the natural, ecological, scenic, recreational and scientific values of wilderness as a result of the selection of this Alternative. Although the effects of the use of Prescribed Fire could be cumulative (in addition to the effects from Wildland Fire Use), it is more likely that the use of Prescribed Fire would substitute for Wildland Fire Use or vice versa. As a result, the

effects of this Alternative would be very similar to those described above under Alternative 2: Wildland Fire Use. The primary difference would be that prescribed fires would be intentionally set to benefit park resources. Each fire would be managed within a predetermined boundary and as a result would be relatively small. Most would be conducted as either research burns to achieve specific resource objectives, (e.g. to remove fine fuels in the white bark pine community to stimulate natural regeneration of this species) or as actions to increase defensible space around developed areas with sensitive administrative or cultural resources. As a result, prescribed fires would result in a moderate degree of human intervention in wilderness, with the attendant impacts of using drip torches or fusees and other equipment to conduct the fire. Prior to the use of prescribed fire in wilderness, additional analysis would occur. Analysis here is necessarily brief and deferred by the lack of Prescribed Fire planning in the park. Upon development and peer review, park prescribed fire plans would undergo individual environmental analysis, including public review. Other impacts of conducting Prescribed Fire in wilderness would be similar to those described for Wildland Fire Use above, including similar impacts on other wilderness values not described above.

Alternative 4 Wilderness Impacts

As in Alternative 3, impacts related to Fire Suppression and Wildland Fire Use would be the same as Alternative 2 and impacts related to Prescribed Fire would be the same as Alternative 3.

Hazard Fuel Reduction (Debris Burning): As mentioned above, this activity could take place to a limited extent in wilderness. Because debris piles would conform to guidelines previously identified, would be localized and campfire- like, and would occur in the vicinity of historic structures, it would have negligible effects on wilderness. Such negligible effects would be the ability to smell smoke in the vicinity of this area. These negligible effects would be slightly greater under this Alternative as a result of the increased extent of this fire hazard reduction. The number of days where burn piles were ignited would increase, but in conformance with local air quality regulations, would be conducted when these impacts would have the least effect. The use of selective debris burning of accumulations of fuel collected in developed areas would also have a negligible minor beneficial effect in increasing the ability to control wildland fires that affected these areas.

Hazard Fuel Reduction (Manual/Mechanical Treatment): Unlike Alternative 1 where this activity would not be conducted in wilderness, a more comprehensive program of hazard fuel reduction would be undertaken. Treatment of hazard fuels would continue to focus on developed areas adjacent to historic structures and along roadsides, but would also include treatment using the minimum tool, of cultural resources sites and structures in wilderness, including wilderness cabins and shelters. This activity would have a minor to moderate beneficial effect on the preservation of cultural resources wilderness values and a negligible effect on the wilderness experience of park visitors, including their experience of solitude and a primitive, unconfined recreational experience. There would be negligible indirect effects on other wilderness values, including natural, ecological and scenic values. There would be no effect on the social or geological values of wilderness.

Alternative 5 Wilderness Impacts

This Alternative would result in the same Fire Suppression and Wildland Fire Use impacts as Alternative 2, and the same Prescribed Fire impacts as Alternative 3. It could, however, result in slightly different Hazard Fuel Reduction impacts than in Alternative 4. That is, a long- term slight beneficial impact could result from a more comprehensive program of hazard fuel reduction in developed areas by potentially reducing or eliminating the need for the limited use of prescribed fire use in these areas. As a result, there would be a negligible decrease in the impacts of fire management on wilderness than would a broader application of the use of Prescribed Fire in developed areas. The use of selective debris burning of accumulations of fuel collected in developed areas or near historic structures in wilderness would also have a minor beneficial effect in increasing the ability to control prescribed or wildland fires that affected these areas. As described above, the same mitigation strategies would be used to minimize or eliminate the effects of fire suppression activities on park wilderness.

Summary/Cumulative Impacts: Alternative 1, with increased use of fire suppression (including the potential for greater attendant impacts on wilderness values) and its alteration of the park's natural fire regime, would have a minor to major long- term adverse impact on wilderness values and has the potential to result in impairment. Continued indefinitely, fire suppression would gradually lead to significant changes in vegetation patterns and wildlife population dynamics and distribution and would therefore adversely affect other natural and scenic qualities of park wilderness. Alternatives, 2- 5, which include some measure of wildland fire use would also result in minor to major adverse impacts and cumulative long- term beneficial impacts on the natural, ecological, scenic, scientific, cultural and recreational values of wilderness. Alternatives 3 and 5 would result in additional moderate impacts to wilderness from human intervention to ignite, control and manage prescribed fires. The above- described range of potential impacts (Alternatives 2- 5) would not result in impairment to wilderness or wilderness values or the reasons these have been protected in Mount Rainier National Park.

VISITOR EXPERIENCE

Park visitation records show that the summer months (June through September) are typically the busiest tourist months. This period coincides with the primary fire season. Since it is difficult to directly correlate tourism spending (dollar figures) with the fire management alternatives, this assessment addresses the relative expected impacts of alternatives on visitation.

Over the past 100+ years, road closures have occurred only occasionally due to fire management operations. Area closures lasted a few days while crews were mobilized and while visitor use areas were occupied by fire crews for camps, staging areas, and helibases. Road closures become necessary when are directly adjacent to a road or trail, and fire crews and aircraft were required to extinguish and/or mitigate snags of the fires. Road closures generally affect a single road, area or small portion of the trail system and it is difficult to assess if visitors simply utilized a different area of the park while they were displaced by fire activities or if they left the park entirely. At other times, visitors were escorted through the work area during halts in aircraft use or when fire activity allowed safe passage. Overall, these closures are extremely rare within the park, since most fires are small and occur off the road or away from trails.

Park Access/Range and Enjoyment of Visitor Activities/Recreational Opportunities

Alternative 1 Park Access/Visitor Activities Impacts

Because the park fire season (primarily June 21 through September 10) coincides with the primary visitor use season (late May through late September), there would be a range of short- term minor to moderate impacts to the visitor experience as a result of the Alternatives proposed herein. Effects on the visitor experience would include additional information needs for planning, and changes in short- term restrictions on park access, and in the number and types of interpretation and education programs and recreational opportunities available.

During periods of high fire danger or wildland fire ignitions, visitors would need additional information about these and how they affected their planned or current visit. Fires burning within the park or in nearby surrounding areas could result in temporary road closures, smoke- obscured scenic vistas, health effects on sensitive visitors, and short- term changes in park regulations regarding front- country fires or wilderness use.

Fire Suppression: Under this Alternative, fire management operations would include detection, monitoring and suppression. Depending on the location, timing and extent of the ignition, these operations could result in temporary impacts to the visitor experience. Such impacts would include (as mentioned above):

- changes in scenic vistas, although every effort would be made to protect "integral vistas" as defined by amendments to the Clean Air Act;
- increases in noise effects (related to fire operations activity and the use of mechanical equipment);
- the odor and drift of smoke;
- potential negligible to minor health effects related to the presence of smoke and ash;

- temporary closures of trails and/or roads or traffic delays to facilitate firefighting efforts or to provide for visitor safety;
- loss of ability to visit some park attractions;
- some confusion as to available visitor services;
- increased concentrations of people where fire camps were established;
- changes in interpretive services (closures of visitor centers or other facilities or cancellation of campfire programs or walks, etc.);
- use, or an increased use (depending on whether the experience was in front country or wilderness) of mechanical equipment, such as aircraft, pumps, chainsaws and other power tools; and
- restrictions on campfires or wilderness access.

Trails could be closed for a few days to a few weeks or more during and after large suppression efforts. Following the fire, visual impacts such as blackened terrain, fire scars, an increase in airborne ash, etc. could occur. If retardant were used, these impacts would be visible as well. In this Alternative, the areal extent of fires would be relatively small, since suppression efforts would begin immediately following detection. To a large extent these impacts would be negligible based on the expected size of most suppression fires. As fire size increased, so would the attendant impacts on the visitor experience.

To mitigate some of the potential visitor experience impacts associated with large or small fire suppression activity the park would increase its information program by disseminating fire information both within and outside the park and would add information staff at turnaround points.

Fires would also result in some long- term beneficial effects on the visitor experience, by providing:
- enhanced preservation of park ecosystem processes, including direct effects that visitors could observe over time;
- potentially enhanced scenic vistas of areas long- disguised by vegetation;
- new educational opportunities to understand disturbance effects on park ecosystems;
- better understanding of park operations;
- potentially enhanced wildlife and wildflower viewing, etc.

Overall, the impacts of fire suppression on the visitor experience under Alternative 1 would be negligible to moderate.

Hazard Fuel Reduction (Limited Debris Burning): There would be no or only negligible effects on the park visitor experience as a result of this activity. As mentioned earlier, it would take place in a limited way in a designated area, resulting in localized smoke during good air quality periods, which are generally outside of the primary visitor use season.

Hazard Fuel Reduction (Limited Manual/Mechanical Treatment): This activity would have a negligible to minor effect on the visitor experience. While some visitors could encounter traffic delays due to limb trimming or mowing activities, most would not encounter delays. Because there would continue to be a focus on treating developed areas under this Alternative, most visitors would not encounter the effects of hazard fuel reduction. Although some brush piles might be evident, these would not be burned (as mentioned) near the primary visitor use developed areas. Some noise and activity might be noticed as accumulations of debris were removed or chipped.

Alternative 2 Park Access/Visitor Activities Impacts
Impacts associated with Fire Suppression under this Alternative would be the same as Alternative 1.

Wildland Fire Use: Visitor Experience impacts related to Wildland Fire Use would be greater than those related to Fire Suppression on visitor access and activities. Typically, since fire size would likely increase, the relative size of impacts would also increase. These impacts would be the same as described above under *Fire*

Suppression effects of Alternative 1. Under this Alternative, these impacts would primarily remain negligible to minor but could become moderate to major depending on the location, timing, extent and severity of the fire and whether or not it went out of a resource benefits strategy and suppression tactics increased. Wildland fires have a greater potential to be active for the remainder of the fire season. If the project starts in June, it could continue through the middle of October and exhibit a range of fire behavior, from smoldering to active flaming fronts.

Alternative 3 Park Access/Visitor Activities Impacts
Impacts related to Fire Suppression and Wildland Fire Use would be the same as described above under Alternatives 1 and 2.

Prescribed Fire: Prescribed fires would likely result in the same impacts as those described above under Alternative 1 and 2 (Fire Suppression and Wildland Fire Use). Overall, since the use of Prescribed Fire would occur under more controlled situations and would be preceded by individual impact analysis of burn plans, impacts to park resources would be defined and mitigated to the extent possible.

Alternative 4 Park Access/Visitor Activities Impacts
Impacts associated with Fire Suppression would be the same as Alternative 1 and impacts from Wildland Fire Use would be the same as Alternative 2.

Hazard Fuel Reduction (Debris Burning and Manual/Mechanical Treatment): Since these programs would increase under this Alternative, impacts would also increase. These impacts, however, would be similar to those described under Alternative 1 for these activities. Visitors would have an increased potential to encounter noise and activity from limb removal or mowing, chipping or debris burning. But, since these activities would not be widespread nor affect the majority of visitors, they would continue to be negligible to minor.

Alternative 5 Park Access/Visitor Activities Impacts
This Alternative would result in the same Fire Suppression impacts as Alternative 1, the same Wildland Fire Use impacts as Alternative 2, the same Prescribed Fire impacts as Alternative 3 and the same expanded Hazard Fuel Reduction impacts as Alternative 4.

Alternatives 1-5 Information, Interpretation and Education Impacts
Under Alternative 1, current information and education programs would be continued. Under Alternatives 2- 5, these would be expanded as indicated above and would result in a minor to moderate beneficial impact on visitor understanding of the park fire management program. During high fire danger, or times when the park was engaged in active fire use [including both Wildland Fire Use (Alternatives 2- 5) or Prescribed Fire (Alternatives 3 and 5)] or Fire Suppression, there would be a minor to moderate increase in the availability of information related to the park fire management program. This would include updates posted on the park's website, press releases developed for the media and interpretive programs highlighting these activities.

Summary/Cumulative Impacts: Alternatives 1- 5 could result in minor to moderate impacts on visitors. Fires burning within the park or in nearby surrounding areas could result in temporary road closures, smoke-obscured scenic vistas, health effects on sensitive visitors, and short- term changes in park regulations regarding front- country fires or wilderness use. Following the fire, visual impacts such as blackened terrain, fire scars, an increase in airborne ash, etc. could occur. If retardant were used, these impacts would be visible as well. To a large extent these impacts would be negligible based on the expected size of most fires. As fire size increased, so would the attendant impacts on the visitor experience. The range of potential impacts (Alternatives 1- 5) would not impair the park visitor experience in Mount Rainier National Park.

PARK OPERATIONS AND VISITOR SERVICES

There would be a wide range of impacts to park operations and visitor services as a result of the Alternatives discussed herein. Under fire suppression or use management scenarios, these impacts would include changes in visitor services, redirection in park operations and potential human health and safety impacts.

For the most part, park fire operations are funded out of national sources and do not result in major impacts on park operations budgets. Although there would be some opportunity to "backfill" positions, for instance, where firefighters were called out of the park for long periods, many short- term call- outs would be absorbed by park operations. This could result in fewer staff available to manage a variety of park operations during periods of high national alert or extensive park fire management operations. Firefighters come from within the organization as a whole, including administration, maintenance, law enforcement, resources, and interpretation staff. Trained firefighters are available to park, agency and interagency operations. During periods of high national alert or extensive park fire management operations, there could be fewer staff in visitor centers, reduced visitor center operations, cancellations in interpretive programs such as walks and talks, fewer patrols of park campgrounds, and other effects on visitor services. These impacts would be partially compensated for by the provision of increased fire information to visitors, the media and park staff. As appropriate, major and minor park developed areas, such as Longmire, Paradise, Carbon River, Ohanapecosh and others would be used to stage fire operations, including personnel, fire camps, etc. In localized fire management efforts, portions of park campgrounds, even whole campgrounds, could be closed to visitor use to provide for public safety or to facilitate fire suppression efforts. As a result, there could be a wide range of reduced visitor services, including negligible to moderate trail, road and area closures that would have concurrent changes in visitor services as well. These could result in loss of concession revenue, interruptions in scientific studies, and changes in the way park visitors would access services and facilities. Loss of concession revenue would be compensated for (to the degree possible) by increased use of concession facilities to stage fire management operations. Closures in visitor use of these facilities would be limited to the degree possible since the experiences they provide would be protected in a similar manner to sensitive park resources and facilities under Wildland Fire Use (Alternatives 2- 5) or Prescribed Fire scenarios (Alternatives 3 and 5). Increased air operations for fire monitoring or suppression or evacuations would result in increased noise and activity and could increase safety hazards for visitors and employees.

As needed, rehabilitation efforts to reopen closed portions of the park to visitor use would occur, including analysis of safety issues, such as the potential for hazards left from fire management operations, etc. Other efforts would include repairs to existing roads, bridges or other damaged facilities; installation of water bars where increased runoff would be expected; culvert and roadside ditch cleaning or installation of racks or screens to facilitate potentially increased runoff, etc. There would also be a variety of ongoing post- fire monitoring to:

- assess fire effects on park resources;
- ensure that treatment or rehabilitation measures were working as designed;
- determine when the usefulness of rehabilitation measures has been exhausted; and to
- conduct condition assessments of fire damaged facilities, etc.

In addition to the effects of the above- described effects on ongoing park operations, there would be an increased potential for park staff and, in some cases, visitors, to be exposed to a wide variety of human health and safety effects. Most of these would relate to firefighters, including encountering steep slopes, uneven terrain, variable fire behavior, smoke emissions, proximity to flames, and other changing environmental conditions. Wildland firefighting and other fire operations require the use of sharp hand tools, power tools and aircraft, including small planes and helicopters.

A primary goal of fire management under any alternative, is to ensure safety for fire fighters, visitors, residents and park employees and to protect property and other values at risk. As a result, all management activities would be evaluated to determine risks to human health and safety. No action that threatens human safety would be taken, unless that threat can be mitigated using standard approved fire management

techniques (such as guidelines for constructing fire line downhill, LCES (establishing lookouts, communications, escape routes and safety zones), and following the ten standard fire orders. All personnel on fires would have and use recommended PPE and would receive a briefing using the briefing checklist in the Incident Response Pocket Guide (see FMP).

The risks of these operations would be managed through the use of established safety precautions, including those listed below.

- Use of safety guidelines in the Fireline Handbook (National Wildfire Coordinating Group Handbook 3, January 1998). These guidelines include, but are not limited to, use of personal protective equipment (PPE), standard fire orders, watch- out situations, and safety issues common to large fires.
- Job Hazard Analyses (JHAs) prepared to identify hazards and mitigation related to individual fire positions and activities.
- Qualifications standards. All personnel assigned to fires must meet NPS and interagency wildland fire qualification standards.
- Site Specific Plans (including Wildland Fire Situation Analyses, Prescribed Burn Plans, Hazard Fuel Reduction Project Plans, Incident Action Plans, and Wildland Fire Implementation Plans.
- Washington State Smoke Management Plan. All prescribed burning and debris disposal would comply with regulations contained in the Washington State Department of Natural Resources Smoke Management Plan. Small burn piles up to about six feet in diameter and would contain less than 100 tons (109,718 kilograms) of natural vegetation. (This meets the definition of small fires under the smoke management plan.) For prescribed fires that would consume 100 tons or more of material, the park would apply to Washington Department of Natural Resources, including the Department of Ecology for smoke management approval. Burns would be timed to minimize smoke impacts on air quality and visibility utilizing favorable conditions of atmospheric stability, mixing height and transport winds. No piles would be ignited during smoke management burn bans or *visibility protection periods* (including from about Memorial Day to Labor Day).
- Daily evaluation of fire danger ratings.
- Ongoing public and employee education.
- Campfire restrictions. During periods of high fire danger the Superintendent may restrict campfires to reduce the chance of escaped or unwanted fires: information about current fire restrictions is made available to the public through press releases; notices provided at ranger stations, visitor centers and trailheads; and visitor contacts.
- Area closures. If wildland fires or wildland fire use pose an imminent threat to human health or safety, the park Superintendent may close all or a portion of the park, including trails and roads, based on recommendations from the Incident Management Team. Park personnel will notify visitors obtaining permits for backcountry use of the exact location of fire activity. Adjacent land management agencies and nearby residents would also be notified if any fire poses a possible threat outside the park.

MIST and best management practices not mentioned above that apply to reducing impacts to human health and safety include:

- Ensuring that safety is the first priority and primary concern of all firefighters;
- Encouraging firefighters to routinely review and apply the 18 Watch Out Situations and 10 Standard Fire Orders during their incident tenure;
- Posting lookouts;
- Being cautious when felling or burning live or dead trees;
- Not enabling wildlife accessibility to food;
- Clarifying fire orders;
- Maintaining adequate firefighter resources and following established work/rest guidelines;
- Thoroughly analyzing fire behavior given predicted weather conditions;
- Ensuring all required fire analyses are completed as required;

- Wearing or using appropriate personal protective equipment (PPE);
- Using infrared devices to detect hot spots;
- Aerial monitoring of fire;
- Knowledge of terrain;
- Well- trained staff.

Impacts of smoke on public health would also occur, with negligible to minor impacts from small fires or suppression efforts and larger impacts when fires are more extensive or nearer populated areas, including when inversions hold smoke at lower elevations or air currents carry smoke down valley. Large or small fires could smolder for a few days to a few weeks or more. Smoke would be diluted to some degree by mixing and dispersion. The degree to which this would occur would depend on localized and regional weather patterns, topography and other factors. Public information would be expanded when increased smoke management concerns are evident, enabling sensitive people to take appropriate measures to limit their exposure. Drift smoke from fires could affect area travel corridors, including park and other roads, resulting in reduced visibility for drivers, an increased need for traffic control and other effects.

A range of beneficial effects to park operations and visitor services could also result from the implementation of the alternatives discussed herein. These would include better protection of park resources, including ecosystem processes, historic structures and administrative facilities. They would also include better training, including cross- training, of park staff, resulting in a better understanding of fire management and its importance to park resources, as well as skills that are readily transferable to other parks and agency and interagency fire management operations.

Alternative 1 Park Operations/Visitor Services Impacts
Fire Suppression: Overall, the impacts to park operations and visitor services, including human health and safety effects, from this activity would result in negligible to minor effects related to small fires and negligible to major effects related to large fires.

Hazard Fuel Reduction (Limited Debris Burning/Limited Manual/Mechanical Treatment): There would be negligible impacts to park operations and visitor services as a result of these activities since they would be conducted in a limited area under a variety of effective mitigation strategies that would limit human health and safety effects.

Alternative 2 Park Operations/Visitor Services Impacts
Wildland Fire Use: With the addition of Wildland Fire Use to Fire Suppression efforts, there would be a somewhat greater potential for larger fires to occur, wherein larger impacts would result. Nonetheless, depending on the location, extent, timing and other factors related to the fire, these impacts would continue to be negligible to minor for small fires and negligible to major for larger fires. Major impacts would result from widespread or large fires, and thus greater potential for park operations changes, such as area, trail and facility modifications and closures. Without hazard fuel reduction in this Alternative, there would be a greater potential to increase risk to firefighters and residents protecting park structures.

Alternative 3 Park Operations/Visitor Services Impacts
Prescribed Fire: Like the use of wildland fire, the use of Prescribed Fire could have an effect on increasing effects related to park operations and visitor services, including human health and safety. This would depend primarily on fire size, but also on location, extent and severity. Overall, the use of prescribed fire could result in some benefits over Wildland Fire Use, due to the greater analysis of specific proposals or burn plans that would occur following development of a park prescribed fire plan. Nonetheless, the range of impacts would continue to be negligible to major depending on a variety of factors related to implementation and management. As in Alternative 2, without hazard fuel reduction in this Alternative, there would be a greater potential to increase risk to firefighters and residents protecting park structures.

Alternative 4 Park Operations/Visitor Services Impacts
Impacts associated with the implementation of this Alternative would be the same as impacts from Alternative 1 and 2. No greater degree of park operations effects would be found since an expanded program of Hazard Fuel Reduction (debris burning and Manual/Mechanical treatment) would be conducted with appropriate staffing, timing and without the heightened emergency or critical timing issues in Wildland Fire Use or Prescribed Fire.

Alternative 5 Park Operations/Visitor Services Impacts
Impacts associated with the implementation of this Alternative would be the same as described above under Alternative 2, dependent on fire location, extent, severity and timing. They would also include the same Hazard Fuel Reduction impacts described in Alternative 1 or 4. Overall, since this Alternative would provide greater flexibility in applying the right fire management strategy to its most appropriate situation, there might be more limited effects on park operations. Unlike Alternative 1, there would not be a rush to extinguish every lightning strike. Under some situations, Wildland Fire Use (as under Alternatives 2 *et seq*.) would result in low intensity fires that might smolder for weeks and then go out, resulting in minimal impacts to park operations (other than monitoring efforts).

Summary/Cumulative Impacts: There would be a wide range of short- term negligible to major adverse effects on park operations and visitor services depending on the location and size of the fire or fire management activity. These impacts would result in area closures, human health effects, and changes in staffing, funding and visitor services activities. Alternative 1, with hazard fuel reduction and fire suppression would have the greatest long- term effects since it would be most likely to result in a greater degree of catastrophic fire. Without hazard fuel reduction, Alternative 2 could result in greater hazards to park employees from the need to protect structures which would be closer to available fuels. The use of prescribed fire in Alternative 3 would result in more small, controlled fires distributed appropriated throughout the park and would begin to reduce the potential for widespread catastrophic fires but the lack of hazard fuel reduction would result in impacts similar to Alternative 2. Without prescribed fire, Alternative 4 could result in a much greater program of hazard fuel reduction than in other alternatives. Over time, Alternative 5 would result in the greatest flexibility associated with reducing the impacts of fire management actions on park operations and visitor services. The above- described range of potential impacts (Alternatives 1- 5) would not impair park operations or visitor services in Mount Rainier National Park.

SOCIOECONOMICS
Alternatives 1-5 Socioeconomic Effects
Each of the fire management strategies described herein would likely result in impacts to the local and regional economy, albeit regional economic effects would likely be indistinguishable in the absence of large catastrophic wildland fires. Firefighting, fire management operations and other aspects of the park fire management program described herein could result in a negligible to minor impact on area economies. The range of park operations that could result in local economic effects include the size of the fire management payroll, the amount of goods and services procured locally, and the impacts of fire operations and smoke or other fire effects on changing park visitation during localized or widespread fires.

Loss in tourism revenue could, in some cases, be compensated for by the presence of large number of wildland firefighters. This would be particularly true with respect to substituting wildland firefighting operations in areas typically frequented by visitors (including meal preparation, the purchase of goods and services, and lodging). Similar impacts or benefits would result from the closure of park areas containing these concession services. The same is also true of socioeconomic impacts related to park area, road or trail closures or widespread fire management activities.

There would be negligible differences among alternatives in their potential for socioeconomic impacts. Use of any of the fire management strategies, either alone or in concert, as described in the Alternatives, could result in similar impacts since many of their impacts would be consistent with fire location, extent (size), severity and ability to achieve resource benefits, rather than fire management strategy. In other words, one

large or a number of small but widespread out- of- control fires could result in an influx of a major firefighting effort. Catastrophic fires that resulted in widespread or prolonged closures or smoke dispersion would be expected to have greater impacts. Depending on the area of the park affected, these fires could result in benefits to local or concession economies. On the other hand, the fire management program base operations costs would remain relatively constant depending on fire frequency and the potential for increased Hazard Fuel Reduction, Wildland Fire Use or Prescribed Fire. Base operations costs are primarily spent on permanent and seasonal staff who live and work in communities near the park, resulting in consistent expenditures on housing, goods and services and food costs spread throughout the year (with a focus on the high density visitor/high frequency fire season in the summer/fall. A negligible increase in park staff would be needed to carry out the park's preferred alternative with respect to the use of the proposed Prescribed Fire and Hazard Fuel Reduction strategies. Other Alternatives proposing these program strategies would also result in negligible increases in staffing.

Summary: The above- described range of potential impacts (Alternatives 1- 5) would not impair the socioeconomic values of Mount Rainier National Park.

ENVIRONMENTAL JUSTICE

Alternative 1 Environmental Justice Impacts

Alternative 1 would continue to result in continued fire suppression and would not resolve long- standing Native American concerns about the absence of fire in former traditional use landscapes.

Alternatives 2-5 Environmental Justice Impacts

As a result of the implementation of this plan, landscapes and resources traditionally used by Native American populations would, over time, return naturally to more closely reflect a pre- fire suppression state with the use of Wildland Fire for Resource Benefits under Alternatives 2, - 4. Future prescribed fire plans under Alternatives 3 or 5 could be used to recreate traditional landscapes as warranted through additional research and consultation with affected Indian Tribes.

CUMULATIVE IMPACTS SUMMARY

A cumulative effects analysis considers the effects of past, present, and reasonably foreseeable future actions on land uses that could add to (intensify) or offset (compensate for) the effects on the resources and that may be affected by the FMP alternatives. Cumulative effects vary by resource and the geographic areas considered here are generally the park and areas adjacent to the park.

Summary of cumulative effects: As noted throughout this assessment, fire affects a wide range of ecological processes, from population dynamics to nutrient cycling and hydrologic regimes. It may completely change plant community composition over broad areas for decades or it may invigorate existing plant communities, resulting in only a change in age structure, such as when seeding or root- crown sprouting predominates in a vegetation type. The most apparent effect of fire is the removal of some or all of the vegetation cover, depending on fire severity. Vegetation recovery, in turn, is dependent on the timing, frequency and severity of fire.

Depending on the fire, vegetation changes may be short or long- term. Extensive burns in old growth forests, such as those at Mount Rainier that provide refuges for late- successional dependent species (e.g. northern spotted owls and marbled murrelets) could result in relatively localized impacts to these species in the park that when contrasted with regional population decline would appear large. To the degree possible, avoiding or minimizing these impacts would be part of the decision to use wildland or prescribed fires (where possible given the selected alternative). Taken together, human impacts to northwest ecosystems have resulted in widespread landscape level changes to the Pacific Northwest and thus fewer refugia for these species.

In surrounding national forests, fire management plans emphasize the natural role of fire, while providing for public and firefighter safety. Over time, however, these surrounding forests, have in many locations, been modified by other forest management practices, such as timber harvests. As a result, there are few natural landscapes where natural processes predominate. Exceptions include surrounding wilderness and late successional reserves.

The limited fire management program proposed by Alternative 1 would continue to result in parkwide fire suppression coupled with a limited degree of hazard fuel reduction. Alternative 1 would, over time, continue to alter the landscape of the park, changing the natural fire regime that included fires of a range of intensities as well as catastrophic fires. Alternative 1 could eventually result in a noticeable change in park plant communities, including wildlife habitat, park operations and visitor services.

Alternative 2 would begin to return a natural range of variation associated with fire to the park by enhancing the park's ability to choose which fires could be utilized for resource benefits and which should be managed under a suppression strategy. Over time, this Alternative would result in a landscape modified by a range of natural fires. Without the use of hazard fuel reduction and/or prescribed fire, however, natural fires under this Alternative would likely be more difficult to manage around human- modified landscapes in the park.

The impacts of Alternative 3 would be similar to Alternative 2, but would include another option for managing fires in the park – prescribed fire. Unlike Alternative 2, prescribed fire could be used to control fires around park structures, by decreasing the accumulation of fuels near developed areas and other structures. Prescribed fire would also likely be used to restore park fire- dependent plant communities.

The impacts of Alternative 4 would be similar to Alternative 3, however in this Alternative, hazard fuel reduction, rather than prescribed fire would be used to decrease the accumulation of fuels near developed areas and other structures, resulting in similar effective protection of historic structures from fire.

Alternative 5 would result in a high degree of flexibility for the fire management program and would capitalize on the benefits of using fire and other fire management strategies to achieve desired natural and cultural resource conditions while simultaneously protecting sensitive park resources and surrounding lands from the adverse affects of fire. As a more proactive wildland fire use management program, it would also likely reduce overall fire- fighting costs. While fire management activities under this Alternative may cause negligible to moderate or even major short- and long- term impacts to park resources, they would also contribute substantially to long term improvement or maintenance of vegetative patterns, wildlife habitats, wilderness processes, human health and safety, and the visitor experience.

RELATIONSHIP TO FIRE MANAGEMENT PLANNING IN SURROUNDING NATIONAL FORESTS

Similar to the preferred alternative (Alternative 5), noted in this Environmental Assessment, surrounding national forests employ a variety of fire management strategies that differ depending on the management area identified in their Forest Plan (see Appendix 3 for an example from the Gifford Pinchot National Forest). By the same token, Mount Rainier National Park Fire Management strategies vary, but are flexible enough to ensure that boundary areas can be managed similarly to strategies used on surrounding non- park lands. For instance, where there are adjoining congressionally reserved areas or wilderness, fires would be managed cooperatively with the adjacent national forest and a joint decision made during the situation analysis process. On the other hand, boundary areas adjacent to private lands not willing to accept fire would be managed more conservatively. As a result, over time, park lands adjacent to wilderness may experience natural fire rotation, whereas park lands adjacent to private lands, would be managed differently depending on the park's ability to control fire with natural features near these park boundary locations.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

As described in the National Environmental Policy Act, the Environmentally Preferred Alternative is the alternative that would:

- fulfill the responsibilities of each generation as trustee of the environment for succeeding generations

- ensure for all Americans, safe, healthful, productive and esthetically and culturally pleasing surroundings
- attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences
- preserve important historic, cultural and natural aspects of our natural heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice,
- achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities
- enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

In this environmental assessment, Alternative 5 has been designated as the environmentally preferred alternative. Alternative 5 contains the widest range of options to manage fire in Mount Rainier National Park. As a result, it would allow the National Park Service to select the strategy with the best outcome for the preservation of park resources. Like the other Alternatives, Alternative 5 would also result in enhanced cooperation and collaboration with surrounding land managers. Like the other Alternatives, Alternative 5 places the highest priority on safety and resource preservation.

XI. CONSULTATION AND COORDINATION

This environmental assessment is available for a thirty- day public review period from _____ to _____. A press release will be distributed to local news media regarding this availability. This report will also be mailed to a list of persons and agencies that have expressed interest in Mount Rainier National Park proposed actions and events. Included will be organizations such as The Wilderness Society, the Sierra Club, The Mountaineers, Mount Rainier National Park Associates, etc. This document will also be mailed to local libraries and be posted on the park's website located at http://www.nps.gov/mora.html.

Comments on this EA should be directed to:

Superintendent
Mount Rainier National Park
Tahoma Woods, Star Route
Ashford, WA 98304.

If reviewers do not identify substantial environmental impacts, this Environmental Assessment will be used to prepare a Finding of No Significant Impact (FONSI) which will be sent to the Regional Director, Pacific West Region for signature.

For additional information concerning this Environmental Assessment, please contact Environmental Protection Specialist, Rose Rumball- Petre, at (360) 569- 2211, extension 3376. For additional copies of this document, please call Mount Rainier National Park at (360) 569- 2211, extension 2301.

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XII. REFERENCES

Agee, J. K., & Huff, M. H. (1980). Characteristics of Large Lightning Fires in the Olympic Mountains, Washington. Reprinted from the *Proceedings of the Sixth Meteorology Conference*, 117- 123. Seattle, Washington.

Agee, J. K., & Huff, M. H., Smith, L,. & Scott, D. R. M. (1981). Ecological Effects of the Hoh Fire, Olympic National Park, 1980 Annual Report. College of Forest Resources, University of Washington. Seattle, Washington.

Agee, J.K. and Smith, L. 1984. Subalpine Tree Reestablishment After Fire in the Olympic Mountains, Washington. Ecology, 65:3 (810- 819).

Allen, Grenville F. 1922. Forests of Mount Rainier National Park. U.S. Government Printing Office, Washington, D.C.

Anderson, D.R. and K.P. Burnham. 1992. Model Building and Statistical Inferences for Adult Female Northern Spotted owls. Paper presented at 62nd Cooper Ornithological Society Meeting. June 22- 28, Seattle, Washington.

Barro, S.C. and S.G. Conard. 1991. Fire Effects on California Chaparral Systems: An Overview. Environment International 17:135- 149.

Boxberger, Daniel L. 1998 The Legal Context of Native American Land and Resource Use in Mount Rainier National Park. Prepared for the National Park Service, Seattle, Washington. Western Washington University.

Burtchard, Greg, S.C. Hamilton, and R.H. McClure. 1998. Environment, Prehistory and Archaeology of Mount Rainier National Park, Washington. Seattle, Washington.

Burtchard, Greg and Steven Hamilton. 1996. Archaeological Resources of Mount Rainier National Park, Washington: 1995 Reconnaissance Data. Report on File, Mount Rainier National Park, Longmire, Washington.

Calvert, Melissa. 2003. Muckleshoot Indian Tribe comments on pre- draft version of Mount Rainier National Park Fire Management Plan Environmental Assessment.

Carr, Ethan. 1997. Mount Rainier National Park National Historic Landmark Nomination, National Register of Historic Places. National Park Service.

Carr, Ethan. 1998. Wilderness by Design: Landscape Architecture, and the National Park Service, Lincoln, Nebraska, University of Nebraska Press.

Catton, Theodore. 1996. Wonderland: An Administrative History of Mount Rainier National Park. National Park Service, Cultural Resources Program, Seattle, Washington.

Dunbar, D.L., B.P. Booth, E.D. Forsman, A. E. Hetherington, and D.J. Wilson. 1991. Status of the Spotted Owl, *Strix occidentalis* and Barred Owl, *Strix varia*, in Southwestern British Columbia. Canadian Field Naturalist. 105:464- 468.

Franklin, Jerry F. and Miles Hemstrom. 1982. Fire and Other Disturbances in the Forests of Mount Rainier National Park. U.S. Forest Service, U.S.D.A., Corvallis, Oregon.

Franklin, J.F., Moir, W.H., Hemstrom, M.A., Greene, S.A., and Smith, B.G. 1988. The Forest Communities of Mount Rainier National Park. Scientific Monograph Series No. 19. U.S. Department of the Interior, National Park Service. Washington, D.C.

Fritts, Steven. 1991. Wolves and Wolf Recovery Efforts in the United States. *Western Wildlands*.

Hamer, T.E., E.D. Forsman, A.D. Fuchs, and M.L. Walterns. 1994. Hybridization Between Barred and Spotted Owls. Auk 111:487- 492.

Hemstrom, M.A. 1979. A Recent Disturbance History of Forest Ecosystems at Mount Rainier National Park. Ph. D. Thesis. Oregon State University.

Hemstrom, M.A. and J. F. Franklin. 1982. Fire and other Disturbances of the Forests at Mount Rainier National Park. Quaternary Research. 18:32- 51.

Henderson, Jan A. 1973. Composition, Distribution and Succession of Subalpine Meadows in Mount Rainier National Park.

Hobson, F.D. 1976. Classification system for the Soils of Mount Rainier National Park. MS Thesis. Washington State University, Pullman, Washington.

Huff, M.H., & Agee, J.K. (1991). Subalpine forest dynamics after fire in the Pacific Northwest National Parks. University of Washington. Seattle, Washington.

Jones, A. Trinkle. 2000. Draft Bibliography of Fire Effects on Cultural Resources. National Park Service, Western Archeological Conservation Center, Tucson, Arizona.

Jones, L.L.C. and M.G. Raphael. 1991. Ecology and Management of Marten in Fragmented Habitats in the Pacific Northwest. Progress Report. Fiscal Year 1991. Olympia, Washington, Pacific Northwest Research Station.

Mack, Cheryl A. 2003. *A Burning Issue: American Indian Fire Use on the Mt. Rainier Forest Reserve*. Fire Management Today 63:2:20- 24.

Minore, D., Smart, A.W., Dubrasich, M.E. 1979 (cited in Mack above) Huckleberry ecology and management research in the Pacific Northwest. Gen. Tech. Rept. PNW- 93. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Moir, W.H. 1989. The Forest of Mount Rainier National Park. Seattle, Washington, Northwest Interpretive Association.

National Park Service. 2000. National Park Service Management Policies. 2000. U.S. Department of the Interior, National Park Service, Washington Office, Washington, D.C.

National Park Service. 1993. Natural Resources Management Guideline (NPS- 77), National Park Service, Washington, D.C.

National Park Service. 1998. Fire Management Guideline (NPS- 18). National Park Service, Washington, D.C.

National Park Service, Director's Order 18 and Reference Manual on Wildland Fire Management. 2001. Washington, D.C.

National Park Service, Nd. FIREPRO 1979- 1997 Database. Washington, D.C.

National Park Service, Mount Rainier National Park. 1953. Report from Chief Ranger's Office. Report on File, Longmire, Washington.

National Park Service, Mount Rainier National Park. 1979. Fire Control Plan. Report on File, Longmire, Washington.

National Park Service, Mount Rainier National Park. 1988. Fire Management Plan. Report on File, Longmire, Washington.

National Park Service, Mount Rainier National Park. 1994. Wilderness Management Plan. Report on File, Longmire, Washington.

National Park Service, Mount Rainier National Park. 1996. Mount Rainier National Park Marbled Murrelet Inventory and Monitoring Program 1996 Progress Report. Report on File, Longmire, Washington.

National Park Service. 1992. Wildland Fire Resource Advisor's Task Book.

National Park Service. 2001. Mount Rainier National Park General Management Plan Final Environmental Impact Statement. U.S. Department of the Interior, National Park Service, Denver Service Center, Denver, Colorado.

National Park Service, Mount Rainier National Park. 1990. Mount Rainier National Park Restoration Handbook, Longmire, Washington.

National Park Service, Mount Rainier National Park. 1995. Checklist of the Birds of Mount Rainier National Park. Northwest Interpretive Association, Seattle, Washington.

National Park Service, Mount Rainier National Park. Nd. Mount Rainier Fire Atlas 1930- 1979 and 1980. Report on File, Longmire, Washington.

National Park Service, Mount Rainier National Park. 1999. Natural and Cultural Resources Management Plan. Report on File, Longmire, Washington.

National Wildfire Coordinating Group. 1989. Fireline Handbook NWCG Handbook 3. Washington, D.C.

Smith, A.H. 1964. Ethnographic Guide to Mount Rainier National Park. Longmire, Washington.
Sumner and Dixon 1953

Taylor, W.P. and W.T. Shaw. 1927. Mammals and Birds of Mount Rainier National Park. Washington, D.C., U.S. Government Printing Office.

Thomas, J.W., M.G. Raphael, R.G. Anthony, E.D. Forsman, A.G. Gunderson, R.S. Holthausen, B.G. Marcot, G.H. Reeves, J.R. Sedell, and D.M. Solis. 1993. Viability Assessments and Management Considerations for Species Associated with Lake- successional and Old- growth Forests of the Pacific Northwest: The Report of the Scientific Analysis Team, Portland, OR. U.S. Forest Service, U.S. Department of Agriculture.

Thompson, Erwin N. 1981. Historic Resource Study: Mount Rainier National Park. Denver Service Center, Historic Preservation Branch, Pacific Northwest/Western Team, National Park Service, Denver, Colorado.

U.S. Fish and Wildlife Service. 1991. Discovery and Observations of Two Tree Nests of the Marbled Murrelet, by S.W. Singer, N.L. Naslund, S. A. Singer and C.J. Condor 93:330- 339 quoted in Northwest Forest Plan.

U.S. Fish and Wildlife Service. 1992. The Pinyon Jay: Behavioral Ecology of a Colonial and Cooperative Corvid by J.M. Marzluff and R.P. Balda. London, England. T & A D Poyser quoted in Northwest Forest Plan.

U.S. Forest Service, 1994. Northwest Forest Plan (Record of Decision and Final Supplemental Environmental Impact Statement: Management of Habitat for Late- Successional and Old- Growth Forest Related Species within the Range of the Northern Spotted Owl. Volumes I, II, Appendices. Portland, OR.

VandeKamp, M.E. and D. R. Johnson. 1990. A Study of Visitor Attitudes Toward Initiation of a Visitor Transportation System at Mount Rainier National Park. Prepared for the National Park Service, Seattle, Washington, Cooperative Park Studies Unit, College of Forest Resources, University of Washington.

Van Gelder, R.G. 1982. Mammals of the National Parks. Baltimore, Maryland and London, England, The Johns Hopkins University Press.

Appendix 1: Minimum Impact Suppression Techniques, Best Management Practices and Other Mitigation Strategies

General Strategies (affecting multiple resources)

- Increase communication, cooperation and coordination with other park divisions, neighboring agencies, Native American Tribes, and private landowners.
- Comply with all federal and state regulations governing air pollution and smoke management standards
- Comply with all applicable NPS policy and guidelines related to wildland fire management and ecosystem health.
- utilize controlled burn intensities to result in a fast- moving, lower temperature impact fire; and
- require post- fire rehabilitation of fire lines, including efforts to reduce compaction by scarifying the soil, and installing natural erosion barriers.

Air Resources

- No burning would be conducted when air regulatory agencies declare air pollution episodes and impaired air conditions for Pierce or Lewis County.
- Park personnel would obtain updated burning information (1- 800- 323- BURN) on the day of the burn and follow the instructions that apply for the day and location of the proposed burning.
- To limit impacts to visitor use, no burning is permitted during weekends.
- All materials earmarked for burning would be placed in clearly marked piles at designated burn areas, such as the Kautz Creek maintenance area or Ohanapecosh Wastewater Treatment Plant. Proper signage to identify and describe what materials are placed there for burning is necessary.
- Burn piles would be located at least 50 feet from structures.
- As appropriate, flammable debris would be cleared from the area.
- Burning would only be conducted during periods when adjacent fuel moisture was high (with an ignition component of less than 50 percent) and winds were calm or light.
- Adequate suppression equipment and personnel would be on hand (a connected water hose, or at least five gallons of water and a shovel available nearby).

<u>Smoke Management</u>

- limiting the number of acres and amount of fuel burned,
- assessing timing and method of ignition,
- determining the moisture content of fuel,
- and
- coordinating with other agencies and land owners to limit the number of fires occurring simultaneously.

In addition, the FMP would comply with all federal and state regulations governing air pollution and smoke management standards and all applicable NPS policy and guidelines related to wildland fire management and ecosystem health.

Soils

- Selecting procedures, tools and equipment with the least possible impact to the environment;
- Implementing the use of water (bucket drops or wet- lining) as a fire suppression technique;
- Ensuring that firefighting equipment is well maintained to prevent spills of lubricants, fuels or other materials (as well as using ground cloths beneath such equipment to prevent accidental releases);
- Allowing the fire to burn to a natural barrier;
- Using the minimum necessary depth and width on fire line construction;

- Covering fire lines with organic material as part of the rehabilitation process;
- Installing water bars or other silt protection measures in sensitive areas;
- Minimizing the felling of trees and bucking of downed logs along the fire line and within the perimeter of the fire;
- Minimizing the limbing of vegetation adjacent to the fire line;
- Removing or cutting vegetation only as necessary to prevent fire spread;
- Limiting the locations of fire camps, helispots, hand lines, intensive mop- up and other concentrated fire activities to non- sensitive sites;
- Leaving standing dead trees (snags);
- Using native materials for sediment traps;
- Using existing spike camps or camping in resilient areas (rocky or sandy soils) showing signs of recent human disturbance (while avoiding wet meadows, water shorelines and other sensitive areas);
- Avoiding the use of rehabilitated fire line as a travel corridor to minimize soil compaction;
- Lessening soil disturbance by ensuring that hot spots and smoldering fires are out;
- Refraining from creating piles of debris to burn or excessively spreading burning fuels, letting fuels burn out naturally;
- Using mulch or soil netting, as appropriate, to minimize or prevent erosion.

Water Resources

- establishing spike camps at least 200 feet from water sources;
- disposing of human waste either by removing it entirely from the site (preferred) or via a 6- 8 inch deep dispersed "cat- hole:"
- capturing and transporting fire camp gray water to acceptable dump sites;
- using biodegradable soap and containing wastewater associated with its use;
- removal of all garbage, including food scraps regularly;
- rehabilitation of fire lines, including implementing erosion control measures that decrease sedimentation;
- using mulching or check dams, as appropriate, to prevent or minimize sedimentation;
- not altering water courses to fight fire;
- prohibiting the use of chemical retardant, foam and gasoline (without secondary containment) near water resources and avoiding the use of retardant and foam elsewhere;
- dipping from only from approved water sources under established conditions (regarding water depth, sensitive resources and method);
- avoiding fire line construction along steep hillsides above park waters.

Vegetation

- Ensuring that firefighting equipment or supplies are not contaminated with noxious weed seeds (consider steam- cleaning equipment, as appropriate prior to transport into park or use in sensitive areas).
- According to the Mount Rainier Restoration Handbook (1990), the following actions would be used to limit the effects of fire lines on vegetation. Constructed fire lines would be rehabilitated when the fire is out and the fireline is no longer needed for control actions. A rehabilitation plan would be written prior to action. If necessary, fire lines would be filled to grade to prevent channeling of water and attendant erosion. Upon filling to grade, restoration would include replanting with salvaged vegetation or covering with duff and excelsior, as needed. Scattering brush, dead limbs or rocks randomly along the trail could also help to impede water erosion and to camouflage the lines.
- Dependent on the type of terrain, the following minimum standards for fire line rehabilitation from the Wildland Fire Resource Advisor's Task Book (NPS 1992) would be used:

Flat or Gentle Slopes

- Recontour line to match surrounding terrain by pulling soil, litter, duff and rocks back over line
- Remove/recontour trenches

- Scatter piles of slash near and over line
- Flush cut stumps

Steep Slopes

- Rake along contour to create small, shallow trenches across fall line
- Recontour line as above to match surrounding terrain by pulling 2- 4 inches of litter and duff back over line
- Remove/recontour trenches
- Place rock (with previously exposed lichen side up) and logs randomly on fall line to intercept adjacent runoff
- Scatter piles of adjacent slash near and over line
- Flush cut stumps
- Trees to be felled and left on site would not be bucked or limbed, except in developed areas or along designated trails.
- Reseeding, which has largely proven unsuccessful, unless native species are used, would not be undertaken.
- When possible, construction of fire lines would not be undertaken in sensitive subalpine areas.
- Fire camps and other operations assemblages would take place in developed areas or areas where clear indications of recent human disturbance (bare ground) are present.
- Fire lines of the minimum possible depth and width would be used.
- Care would be taken to select suppression tactics, procedures, tools and equipment with the least possible impact to the environment.
- Equipment used in firefighting would be cleaned prior to use in park firefighting efforts.
- Mulches or other rehabilitation treatments, including straw bales would come only from sources approved by the park plant ecologist.

Wildlife

- use of developed areas or areas extensively disturbed by human impacts for staging fire suppression activities
- limiting the types of activities that would be performed at dawn, dusk or night as appropriate to minimize impacts to threatened and endangered species;
- relying on existing trails to the extent possible to access fires
- relying to the extent possible on water sources outside the park for firefighting efforts
- minimizing the use of fire retardant or foams in suppression efforts
- ensuring that firefighting equipment was in good condition and using best management practices to ensure that spills of lubricants, fuels or other chemicals does not occur
- using other minimum impact suppression and mop- up techniques (as described in Appendix 1); etc.

Rare, Threatened and Endangered Species and Habitats

- The park would continue to build its inventory and monitoring program for rare, threatened and endangered species and habitats, including conducting surveys to USFWS protocol as needed to cover future actions proposed by this plan.
- To the extent practicable, Prescribed Fire, under future environmental analysis, would either avoid nesting or spawning seasons or would not be conducted in areas where analysis of rare species and habitat had not been made.
- For naturally occurring Wildland Fire (lightning strikes) and potential future Prescribed Fires, documentation of immediate post- fire threats to rare, threatened and endangered species and habitats and actions to prevent further degradation of these would occur immediately following fire use or suppression activities.
- To the degree possible, direct, fire- related mortality of rare species, including known habitat or activity sites, would be avoided.
- Suppression activities, fire effects monitoring and smoke production would be carefully monitored

in the vicinity of known habitat in the decision process with respect to all fires (including suppression and use).
- To the degree possible, construction of fire lines would avoid known rare, threatened or endangered species habitat.
- During future Prescribed Fires, in known rare, threatened or endangered bird habitat post nesting season, cooler burn prescriptions would be used and some degree of hazard fuel removal could be used to limit the potential for crown fires.
- Alternatives that include Hazard Fuel Reduction would either have no effect, be not likely to adversely affect or would have beneficial effects or they would not be conducted within known or potential habitat for rare, threatened or endangered species. In other words, noise from heavy equipment or chainsaw use above the ambient level would occur more than ¼ miles away from potential habitat. No nest trees or other specific habitat for rare species would be removed.
- In areas below 4,800 feet, helicopters used in wildland fire suppression efforts would fly ½ mile (about 2,600 feet) above the canopy during the early nesting season (March 1- August 6) for both northern spotted owls and marbled murrelets.
- Helicopters would be staged, to the degree possible, during nesting season fire suppression efforts above the elevation of northern spotted owl (4,800 feet) and marbled murrelet (3,500 feet) nesting habitat (e.g. Fourth Crossing rather than Kautz Creek).

Prehistoric and Historic Archeology
- The park would continue to build its inventory and monitoring program for archeological resources, including conducting surface and subsurface testing as necessary to document the potential for archeological resources or to understand the extent of archeological resources found.
- Prior to the development of Prescribed Fire plans (and subsequent environmental analysis), areas proposed for fires would be surveyed for the presence of archeological resources.
- Heavy equipment or other ground disturbing activities would not be used in known sensitive archeological resources sites
- The location and extent of known sensitive archeological resources would be considered in the decision to use wildland or prescribed fire.
- Inclusion of park archeologist in the planning and suppression process
- There would be no fire line construction in the vicinity of known archeological resources.
- As appropriate during archeological assessment and monitoring there would be surface or subsurface surveys accompanied by screening of sediments as necessary to determine the presence or significance of archeological resources.
- If prehistoric or historic archeological resources were discovered during any portion of a proposed action under the implementation of the alternatives that follow, work in the area associated with the find would cease until evaluated by the park archeologist or designated representative. If necessary or possible, relocation of the work to a non- sensitive area may be required to enable completion of additional site testing and documentation. Every effort would be made to avoid further disturbance to the site.
- In the event of a significant find, consultation with the Washington State Historic Preservation Office and Native American tribes would occur and recommendations would be sought for appropriate treatment of the resources located.
- Increased law enforcement patrols in known archeological sites following fires that removed surface vegetation obscuring sites
- Confinement of mop- up activities to smaller areas to allow archeologists more lead time to examine the ground surface before crews complete their work

Historic Structures
- The park would continue to build its inventory and monitoring program for historic resources
- Facilitate the preservation of park historic buildings, structures and cultural landscapes in developed areas by conducting systematic Manual/Mechanical treatment of hazardous accumulations of fuel

near these facilities. Treat 20 percent of the park per year.

- Create defensible spaces, where possible, around developed areas to provide an additional measure of protection for facilities in these areas. By 2006, identify defensible spaces around National Historic Landmark District contributing structures.
- As structures are rehabilitated, increase the use of fire suppression systems and other structural improvements that meet the Secretary of Interior's Standards for Rehabilitation of Historic Structures, resulting in no adverse effect. Prior to the development of Prescribed Fire plans (and subsequent environmental analysis), areas proposed for fires would be surveyed for the presence of historic resources
- Heavy equipment or other ground disturbing activities would not be used in known sensitive archeological resources sites
- The location and extent of known sensitive or significant historic resources would be considered in the decision to use wildland or prescribed fire.
- Inclusion of park historical architect and historical landscape architect in the planning and suppression process
- There would be no fire line construction in the vicinity of known historic resources.
- If historic resources were discovered or affected during any portion of a proposed action under the implementation of the alternatives that follow, consultation with the State Historic Preservation Office would occur. If necessary or possible, relocation of the work to a non- sensitive area may be required to enable completion of consultation and documentation. Every effort would be made to avoid further disturbance to the site.
- Increased law enforcement patrols near affected resources following fires
- Confinement of mop- up activities to smaller areas to allow historic resources professionals more lead time to understand fire effects to historic resources.
- Structural inspections (post- fire condition assessment) of historic structures damaged by fire, including immediate mitigation measures such as bracing or weatherproofing.

Wilderness

- Administrative use of aircraft would be permitted in accordance with Office Order 97- 1:Safety Orientation for New Employees and 79- 8: Aircraft Use Request and subsequent updates. Permission to use helicopters in wilderness is granted by the superintendent. Helicopter use in wilderness (for other than emergencies) would generally not be approved between July 1 and Labor Day and use is restricted to weekdays. Approval for helicopter use in non- emergency situations would be granted only if it has been determined to be the minimum tool to achieve the purposes of the area for protection of wilderness values (Environmental Assessment Appendix 2 and Fire Management Plan Appendix 30).
- There are no existing, constructed helicopter landing zones in wilderness. Natural openings would be used if approved under the minimum requirement for helicopter landing as detailed in the FMP. Minimal clearing would be used in an emergency if other safe alternatives have been ruled out. Site restoration would occur following this use.
- Fixed wing and other aircraft use would conform to FAA regulations and mitigation to minimize or eliminate impacts to endangered species.
- As detailed in the Wilderness Management Plan (1988), temporary work crew camps may be established within trailside camps or other resilient zones as approved by the superintendent (not within view or ¼ mile of established trail). Cache boxes, equipment and supplies would be kept out of sight as possible and removed when no longer needed and restoration would occur upon cessation of use.
- Park use of power equipment is dictated by Office Order 87- 1: NPS Use of Mechanized Equipment and Stock for Administrative Activities Otherwise Not Permitted and the Wilderness Management Plan. The use of Manual/Mechanical equipment is constrained by the Wilderness Act and NPS policy. In determining the appropriate minimum tool for use in wilderness, consideration is given to effects on visitor experience, public safety and wilderness values. Resource protection and safety

concerns would take precedence over economic considerations. Alternative methods to power tools would be considered based on the project objectives and minimum tool concerns. Use of power tools in wilderness would be confined, as much as possible, to the period prior to July 1 and after August 31. Depending on the size of the fire, the minimum tool could be the use of helicopters, chainsaws, portable pumps and air tankers. This would be determined on a case- by- case basis, considering numerous factors as noted above.

- As discussed in the Wilderness Management Plan, the use of the minimum requirement/minimum tool concept would be employed for fires in wilderness. Specific emphasis would be on the natural role of fire in the park ecosystem and the need to modify fire use and fire suppression responses (as appropriate) to minimize their effects. Suppression standards, both tactical and strategic would be used to minimize the environmental effects of suppression activities. Rehabilitation of fire suppression impacts to park resources would occur as part of and immediately following mop- up.

Park Operations and Visitor Services

- assess fire effects on park resources;
- ensure that treatment or rehabilitation measures were working as designed;
- determine when the usefulness of rehabilitation measures has been exhausted; and to
- conduct condition assessments of fire damaged facilities, etc.
- The park information radio frequency (1610 AM) heard at entrance stations and Paradise would be used to inform park visitors of any significant fire activity or smoke that may impact their visit to the park.
- Information explaining fire management programs would continue to be incorporated into interpretive programs, exhibits, videos and nature walks as they are developed.
- During high fire danger, a web site will be developed which will include information about the role of fire in Mount Rainier's ecology, and web updates, including links, would be provided regularly with current information any time a fire is burning in the park.
- Articles for the summer addition of the park's visitor guide for Mount Rainier, the "Tahoma News" explaining fire management policies may be developed and made available for distribution.
- To facilitate information dissemination on a regional and national level, the park would coordinate with a number of national, regional and local agencies, including the National Interagency Fire Center.

- Maps, narrative statements and photographs of the current fire situation and fire danger ratings would be posted during high fire danger or fire operations in area ranger stations and visitor centers.
- As needed, fire information would be reported to surrounding public and private land management agencies.
- On- site visitor interpretive assistance would be initiated on all large fires, which occur near populated or developed areas.
- Fire records, photographs, etc., important to the fire management, interpretive and research programs, would be collected and filed. Public reactions to fire management activities and interviews would be recorded and made part of the fire record.

Human Health and Safety

- Use of safety guidelines in the Fireline Handbook (National Wildfire Coordinating Group Handbook 3, January 1998). These guidelines include, but are not limited to, use of personal protective equipment (PPE), standard fire orders, watch- out situations, and safety issues common to large fires.
- Job Hazard Analyses (JHAs) prepared to identify hazards and mitigation related to individual fire positions and activities.
- Qualifications standards. All personnel assigned to fires must meet NPS and interagency wildland fire qualification standards.
- Site Specific Plans (including Wildland Fire Situation Analyses, Prescribed Burn Plans, Hazard Fuel Reduction Project Plans, Incident Action Plans, and Wildland Fire Implementation Plans.

- Washington State Smoke Management Plan. All prescribed burning and debris disposal would comply with regulations contained in the Washington State Department of Natural Resources Smoke Management Plan. Small burn piles up to about six feet in diameter and would contain less than 100 tons (109,718 kilograms) of natural vegetation. (This meets the definition of small fires under the smoke management plan.) For prescribed fires that would consume 100 tons or more of material, the park would apply to Washington Department of Natural Resources, including the Department of Ecology for smoke management approval. Burns would be timed to minimize smoke impacts on air quality and visibility utilizing favorable conditions of atmospheric stability, mixing height and transport winds. No piles would be ignited during smoke management burn bans or *visibility protection periods* (including from about Memorial Day to Labor Day).
- Daily evaluation of fire danger ratings.
- Ongoing public and employee education.
- Campfire restrictions. During periods of high fire danger the Superintendent may restrict campfires to reduce the chance of escaped or unwanted fires: information about current fire restrictions is made available to the public through press releases; notices provided at ranger stations, visitor centers and trailheads; and visitor contacts.
- Area closures. If wildland fires or wildland fire use pose an imminent threat to human health or safety, the park Superintendent may close all or a portion of the park, including trails and roads, based on recommendations from the Incident Management Team. Park personnel will notify visitors obtaining permits for backcountry use of the exact location of fire activity. Adjacent land management agencies and nearby residents would also be notified if any fire poses a possible threat outside the park.
- Ensuring that safety is the first priority and primary concern of all firefighters
- Encouraging firefighters to routinely review and apply the 18 Watch Out Situations and 10 Standard Fire Orders during their incident tenure
- Posting lookouts
- Being cautious when felling or burning live or dead trees
- Not enabling wildlife accessibility to food
- Clarifying fire orders
- Maintaining adequate firefighter resources and following established work/rest guidelines
- Thoroughly analyzing fire behavior given predicted weather conditions
- Ensuring all required fire analyses are completed as required
- Wearing or using appropriate personal protective equipment (PPE)
- Using infrared devices to detect hot spots
- Aerial monitoring of fire
- Knowledge of terrain
- Well- trained staff

Appendix 2: Minimum Requirement/ Minimum Tool Analysis

Minimum Requirement and Minimum Tool analyses are completed by the park's wilderness coordinator. In most cases, an analysis is initiated through the completion of the park's Proposal, Planning and Review form. Specific questions are asked about a proposed project to determine how that project fits within overall park and wilderness management goals. A section of the form seeks information about the minimum tool required, including the use of mechanized equipment and helicopters.

An interdisciplinary team then reviews the Project Proposal, Planning and Review (PPR) form with the project initiator in a meeting format. Several factors are included in the review including:

1. Project Description – What does the project involve, is it necessary, and where will it occur?
2. Wilderness Management – Are the proposed actions at the minimum level necessary to solve the problem and meet wilderness management objectives?
3. Timing and Occurrence –This section reviews the effect of the project's timing and the frequency that the project's tasks will occur.
4. Use and Duration of Mechanized Equipment – What mechanized equipment is proposed for use during the project and how long will it need to be used?
5. Ability to do Without Mechanized Equipment – Are there alternatives to using mechanized equipment? What is the cost comparison between using mechanized and non- mechanized methods?

The PPR process is the first step in determining the level of environmental compliance that may be required for a project. Depending on the scope of the project and the results of the interdisciplinary team's review, an environmental assessment or environmental impact statement may be necessary.

A Minimum Tool justification form (WMP 1992) and/or Aircraft Use Request form (A- 70) are used for routine (non- project based) work which may require the one- time use of mechanized equipment or helicopters in wilderness. These forms require the work leader and wilderness coordinator to articulate why mechanized equipment is necessary and the effects on wilderness values if mechanized equipment is used. After the document has been reviewed by the wilderness coordinator, it is forwarded to park management for approval or disapproval.

Appendix 2: FIRE MANAGEMENT IN SURROUNDING NATIONAL FORESTS/NORTHWEST FOREST PLAN

Under the Northwest Forest Plan and individual Forest Plans surrounding national forests conduct a similar variety of fire management activities. Planning direction for fire management activities is contained in Forest Plans, which are written for each national forest. Forest Plans, which are mandated by the National Forest Management Act, also establish other land management goals and standards. The Northwest Forest Plan amended area Forest Plans regarding the conduct of specific activities related to their effects on sensitive species associated with old growth forests. This amendment adopted a comprehensive ecosystem management strategy for 19 Forest Service and 7 Bureau of Land Management plans.

For example, national forests, such as the Gifford Pinchot National Forest, use the National Forest Management Analysis System to determine the most cost- effective fire protection organization. Changing conditions result in changes to the organization. According to the Forest Plan, plans for the prevention of human- caused fires will be aimed at specific risks determined by ongoing monitoring of current and recent fire reports. The mix of aerial and ground detection activities will be reviewed periodically to maintain the most cost- efficient combination (Gifford Pinchot Forest Plan Chapter 1).

1. Suppression decisions will be based on an Escaped Fire Situation Analysis (FS- 5100- Z). This analysis will be made for all escaped fires when:
   a) A fire has escaped initial attack or has been determined to exceed the protection objectives of the area.
   b) Alternative suppression strategies can be identified before large expenditures in time or money are incurred.
   c) The fire will extend into the next burning period.
2. Alternative Suppression Strategies which should be considered are:
   a) Confine: To restrict the fire within boundaries established either prior to the fire, during the fire, or in an escaped fire situation analysis. In most cases this will be restricted to Fire Intensity Level (FIL) 1 or 2.
   b) Contain: To surround a fire and any spot fires it produces with a control line which can reasonably be expected to check the fire's spread under prevailing and predicted conditions. It is restricted to FIL 1- 2 and, in isolated cases, 3- 4.
   c) Control: To complete the control line around a fire and any interior islands to be saved, burn out any unburned areas adjacent to the fire side of the control line, and cool all hot spots that are immediate threats to the control line. The suppression strategy to be used will depend on the standards and guidelines for the given management area. The Control strategy may be used whenever the fire hazard is severe.

The Gifford Pinchot Forest Plan also provides a strategy for hazard fuel reduction or "fuels treatment" (Chapter 2):

1. Fuel treatment priorities will be
   - Priority 1: Fuel treatment adjacent to communities where life and property are threatened by wildfire.
   - Priority 2: Fuel management support to functional and project planning.
   - Priority 3: The treatment of prior activity fuels.
   - Priority 4: The treatment of natural fuels where suppression capability alone cannot reasonably assure the cost- efficient attainment of resource management goals and objectives.
2. All slash- creating projects will be analyzed to determine whether slash must be treated.
3. A fuel treatment plan will be prepared for all projects which do not meet acceptable fuel levels.
4. Management activities will not be undertaken if slash cannot be reduced to an acceptable level.

5. Subject to meeting coarse woody debris requirements, the following fire hazard reduction applications should be considered:

a) Utilization: Harvest techniques such as top yarding, improved utilization methods identified in mill operation and log manufacturing studies, and residue treatment methods that optimize firewood use.

b) Rearrangement: Fuels may be redistributed on- site to a less hazardous condition or one which produces faster deterioration or removal.

c) Removal: Fuels may be moved off- site for use, storage, or disposal.

d) Disposal: The reduction or elimination of fuels by prescribed burning or manual, mechanical, chemical, or biological means.

e) Conversion: Replacing flammable vegetation with less flammable material.

f) No reduction.

In Wilderness, or "Congressionally Reserved Areas," the Gifford Pinchot Forest Plan calls for:

1. Use suppression techniques which result in the least possible evidence of human activity.
2. Naturally- occurring fires shall be permitted to burn in specific areas if they meet the prescription parameters for the zone. All naturally- occurring ignitions are considered prescribed until declared wildfire, in which case the appropriate suppression strategies will be used.
3. Under specific conditions as described in the prescribed natural fire plan, prescribed fires may be ignited by forest managers to meet specific Wilderness objectives as described in FSM 2324.22 and the approved prescription parameters for the zone.
4. Detection flights should avoid over- flight of the wilderness.
5. Fuelbreaks will not be constructed.

In "Administratively Reserved Areas" the following strategies are identified:

Fire plans will adhere to state, county, and local fire ordinances and laws.

Fire Suppression Strategy, Control, should be used. Fire Suppression Priority 1, protect life and property, should apply and all fuels will be disposed or removed.

In "Late Successional Reserves" the following strategies are identified:

Fire Suppression and Prevention - Each Late- Successional Reserve will be included in fire management planning as part of watershed analysis. Fire management in Late- Successional Reserves will utilize minimum impact suppression methods. Fuels management will adhere to with guidelines for reducing risks of large- scale disturbances. Plans for wildfire suppression will emphasize maintaining late successional habitat. During actual fire suppression activities, fire managers will consult with resource specialists (e.g., botanists, fisheries and wildlife biologists, and hydrologists) familiar with the area, these standards and guidelines, and their objectives, to assure that habitat damage is minimized. Until a fire management plan is completed for Late- Successional Reserves, suppress wildfire to avoid loss of habitat in order to maintain future management options.

In Late- Successional Reserves, a specific fire management plan will be prepared prior to any habitat manipulation activities. This plan, prepared during watershed analysis or as an element of province- level planning or a Late- Successional Reserve assessment, should specify how hazard reduction and other prescribed fire applications will meet the objectives of the Late- Successional Reserve. Until the plan is approved, proposed activities will be subject to review by the Regional Ecosystem Office.

The Regional Ecosystem Office may develop additional guidelines that would exempt some activities from review. In all Late- Successional Reserves, watershed analysis will provide

> information to determine the amount ofcoarse woody debris to be retained when applying prescribed fire.
>
> In Riparian and Late- Successional Reserves, the goal of wildfire suppression is to limit the size of all fires. When watershed analysis, province- level planning, or a Late- Successional Reserve assessment are completed, some natural fires may be allowed to burn under prescribed conditions. Rapidly extinguishing smoldering coarse woody debris and duff should be considered to preserve these ecosystem elements.

"Matrix Lands" (areas located in the rural interface) fire management calls for coordinating fire management activities

> with local governments, agencies, and landowners during watershed analysis to identify additional factors which may affect hazard reduction goals. Hazard reduction may become more important in the rural interface and areas adjacent to structures, dwellings or other amenities.

Finally, in Adaptive Management Areas, the Forest Plan calls for encouraging fire managers to:

> actively explore and support opportunities to research the role and effects of fire management on ecosystem functions. Cooperation across agency and ownership boundaries should be emphasized. The standards and guidelines in current plans for hazard reduction should be followed until approved Adaptive Management Area plans are established. Fire management experts will participate on the local Interdisciplinary Technical Advisory Panel on the Adaptive Management Area. Management of the Adaptive Management Area is intended to be innovative and experimental. Wildfire suppression actions, however, should use accepted strategies and tactics, and conform with specific agency policy.